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ROYAL BOTANIC GARDENS, KEW

## I.—LEDGER BARK AND RED BARK. J. H. Holland.

In the *Kew Bulletin* No. 3, 1931, pp. 113-117, particulars are given of the introduction of Peruvian or Cinchona bark into India. The article, however, only deals with the subject in a general way and it has been thought desirable to give some information on the introduction of *Cinchona Calisaya* var. *Ledgeriana* to the East and the importance of this species together with *C. succirubra* to the cultivation of Cinchona at the present time.

### The Introduction and Establishment of Ledgeriana.

The story of this introduction is of special interest. It begins in 1851 when Charles Ledger, by whose agency the seeds were collected, was interested in the Cinchona bark and Alpaca wool trade of Peru and Bolivia. In that year he made an attempt to reach the Amazon through the Bolivian Province of Caupolican, and noted on the banks of the Mamore the trees of *Calisaya* from which his seed was obtained some fourteen years later. He was accompanied by his servant Manuel Incra Mamani, an experienced bark collector who had been in his employ since 1843 (Markham, Peruvian Bark, 1860-1880 p. 213). Sir Clements Markham devotes a chapter (l.c. pp. 212-216) to " Mr. Ledger's services in procuring Calisaya from Bolivia " in which he refers to a journey made by Ledger in 1858 to Australia with a flock of Alpacas, and goes on to say that " on his return to South America he heard of the enterprise which I had initiated and put in train for introducing cinchona cultivation into India. It appears that he made some attempt to open up communications with me which unfortunately was not successful." He relates how " in his endeavour to secure a supply of the best Calisaya seeds Mr. Ledger sent for his old servant Manuel in 1861 and gave him the necessary instructions for collecting seeds from the best kinds of Cascarilla trees." It was not, however, until 1865 that the commission could be fulfilled.

The only authority who seems to have been in direct correspondence with Ledger on Cinchona is Mr. John Eliot Howard, who, quoting from Mr. Ledger's original letters (*see* Pharm. Journ. March 13, 1880, p. 730) under date Dec. 22nd, 1874, states :— " Manuel Incra Mamani delivered the seed he had collected in June

1865. He then told me that the best bark trees had not produced ripe seed for four years previously. When the trees were full of flower and most promising a frost (*helada*) in April destroyed it all. The inferior sorts had not suffered. He had been cutting bark with his sons and patiently waited for an opportunity for complying with my orders, obtaining only the best sort."

Howard goes on to say that " the seed producing the Ledgeriana was gathered according to Manuel from about fifty trees, chiefly of the Rojo sort. . . . The *Calisaya Ledgeriana* of Java is, as I have shown, the legitimate produce of the seed of the 50 trees above mentioned. I should think no botanist has been within some hundred miles of the almost inaccessible banks of the Mamore where these were met with. . . . The first portion of the above seed passed into the hands of the Dutch Government. In my work* the reader will find particulars about its reception in Java.

" Owing to Mr. Ledger's good drying and care the seed arrived in such condition that it had not lost its germinative power. I inspected the remainder at the request of the British purchasers and found it apparently of the best quality and condition."

The best account of the final disposal of the seeds would appear to be that of Karel Wessel van Gorkom (" Handbook of Cinchona Culture." Transl. from the Dutch by B. D. Jackson, pp. 90-95) :—

" By July of the same year Ledger had sent the seeds from Arica to his brother in London, to offer them to the English government. As luck would have it an opportunity to enter into correspondence with the English government did not soon present itself, and so the greater part of the seed was bought by Mr. J. W. B. Money, the possessor of extensive Cinchona plantations in British India. With the remainder, Ledger turned to the Dutch government, a preliminary deposit of 100 francs was paid, to which a moderate addition would afterward[s] be added on the germination of the seed in Java, and if it appeared to belong to a good sort. . . . .

" These seeds then came in December 1865 into the possession of the Director of Cinchona culture, who one year afterwards was able to report, that about 20,000 had germinated. Ledger thereupon received a further sum of 500 francs and was therewith well content.

" Meanwhile Money had not himself used the seed he had bought, but had exchanged it for *C. succirubra* seed with McIvor, the head of the Government Cinchona culture in Madras. The reason for this was, that he considered his own plantation to be situated too high for the cultivation of *C. Calisaya*, under which name Ledger had offered his treasure. On the other hand, McIvor had already expressed himself repeatedly as not prepossessed in favour of *C. Calisaya* cultivation. The Ledger seed was sown at Ootacamund but produced no plants, at least if any there were, they were not

*The Quinology of the East Indian Plantations, p. 51—letter from Mr. Moens dated Bandong, Java, 5 Dec. 1873, to Mr. Howard.

specially noticed or mentioned.* From a small quantity parted with to a colleague in Bengal, a few trees were raised in Sikkim which first began to attract attention, when the fame of the Ledger-*Calisaya* spread afterwards from Java."

A footnote on this page adds that " The Superintendent of the Government Cinchona nurseries in Bengal, Mr. Gammie, obtained about 800 plants from Ledger's seed and made so many cuttings from them that in 1880 he planted 10 acres of ground with it. Moens, who has seen this planting, says that the type is quite like that we have in Java, but the plants had not developed so strongly." Watt (Comm. Prod. India, 1908, p. 304) refers to this 10 acres reported by Mr. Gammie (in 1880 at Sikkim) under *Ledgeriana*, which " in time became the parent stock of the plants in the present Bengal Plantations."

In the same year, when the trees of *Ledgeriana* raised from the original stock were apparently producing seeds, the Director of Kew (Sir J. D. Hooker) in Kew Report 1880 (p. 11) stated that " A very large number of applications has been addressed to Kew for a supply of seed. This has been partially responded to, partly through the courtesy of the Dutch Government and partly by a supply from the Indian Government plantations in Sikkim.

" In 1876 some seed was received at Kew from Java, and part of this was communicated to Mr. J. E. Howard, F.R.S., who raised seedlings. He carefully selected the most promising of these . . . and very kindly supplied Kew with cuttings. . . . Three of the rooted cuttings were given to Mr. J. H. Campbell, of Lindoola, Ceylon, who was anxious to have a perfectly authentic strain . . . Three other plants propagated at Kew from the same authentic strain were sent to Jamaica. Mr. Morris reported (September 22) that he was 'delighted with their fine healthy condition.' . . . Mr. Shubrick writes from Greenway, Ootacamund (December 21) a private letter in which there is much interesting information on the local Cinchona culture :—' The Ledgeriana seed from Java reached me quite safely. I sowed it carefully in the open air, and both beds, for I kept the packets distinct, germinated well, but very slowly. Several of my

*Dr. King, in his Manual of Cinchona Cultivation in India (1876) p. 15, states that Mr. Money exchanged " no less than thirteen pounds of seeds of the finest Bolivian varieties of this species [*C. Calisaya*] which had been collected by Mr. Ledger, for a quantity of the Red Bark seed, which had by that time begun to be freely produced on the Nilgiri plantation. These thirteen pounds, on Mr. McIvor's lowest calculation of 20,000 seeds to the ounce, should have yielded four millions of plants. Only 60,000 plants were however raised, but these proved to be of three most excellent sorts."

In a report made to the Colonial Secretary, Ceylon, August 20th, 1880 (*see* Kew Report 1880 p. 33), by Dr. Trimen, it was stated :—" From Mr. Ledger's seed sent to the Nilgiris it is reported that 60,000 seedlings were raised. It would appear that most of these died out, though probably some still exist in Wynaad. A pinch of seed from Southern India was sown in the Sikkim Plantations and Dr. King considers the trees which have resulted there to be precisely the same as some of the forms of *Ledgeriana* which he saw in Java. . . . ."

neighbours got packets from Mr. Moens, the Government Gardens at Neddivattum [Naduvattam], and the Liddellsdale Company large packets ; both had glass houses and their plants did well, though my beds gave infinitely more plants. . . . . ' "

In 1880 *Ledgeriana* was in strong demand in Jamaica where, with the plants sent by Sir Joseph Hooker from Kew, fresh seed direct from Mr. Moens in Java and from Dr. King in India, this valuable plant was being well established by Mr. (now Sir Daniel) Morris. (*see* Kew Report 1881, p. 10).

In 1848 when *Calisaya* was regarded as the most important of the Cinchona barks used in medicine, Dr. Weddell, the French explorer, who had visited the Tambopata valley the previous year, described it as a new species (Ann. Sc. Nat. Series iii, x. p. 6) ; Howard described Ledger Bark as *Cinchona Calisaya* Wedd. var. *Ledgeriana* with Dr. Weddell's concurrence in 1876 (Quin. E. Indian Plantations, p. 84) and Trimen described it as *C. Ledgeriana* Moens, MSS. in 1881 (Journ. Bot. xix. p. 323).*

It may be asked why, when the bulk of the seed which Ledger brought to Europe found its way to India (13 lbs. were bought by Money and only 1 lb. is said to have been sold to the Dutch Government) it was left to the Dutch workers in Java to discover the merits of this plant.

The chief reason for this was that Markham selected the Nilgiris as the main acclimatisation station for the introduction of seed and planting material obtained by him, and by the collecting parties working with him, in S. America. Unfortunately only certain species of Cinchona when tried were found to thrive under the conditions which prevailed there—notably *C. succirubra* and *C. officinalis*. As already quoted, McIvor was not in favour of *Calisaya* types of Cinchona, having seen the failure of the whole of Markham's collection of some 450 plants, which he had with such care collected in the forests of Caravaya, transported over the snow-covered Andes, and finally conveyed in Wardian cases to Ootacamund. It was not likely then that McIvor would expect much success from the Ledger seed, and though he appears to have raised 60,000 seedlings nothing more was heard of them. It was fortunate, however, that a small quantity of this seed found its way to Sikkim, where *Calisaya* was found to thrive fairly well, but, as Moens says, these Ledger seedlings there had not developed as strongly as the plants from the same seed when grown in Java, nor has the bark ever analysed as well. Here fortune was with the Dutch experimenters, as the Ledger seedlings which they raised from Ledger's seed were tried on the volcanic

*With regard to the taxonomy of *C. Calisaya* and *C. Ledgeriana*, we do not consider the latter a distinct species. It may be either a variety or a hybrid of *C. Calisaya*. In the circumstances we recommend that it should be called "*C. Calisaya* var. *Ledgeriana*. Hence in the present paper Ledger Bark is referred to as *C. Calisaya* var. *Ledgeriana*, and occasionally simply *Ledgeriana*. In quoted passages the names given by the respective authors are retained. T. A. Sprague and N. Y. Sandwith.

soils of the Preanger district, which, even at the present time, grows a large proportion of the total Java acreage and produces 75 per cent. of the total Java quinine output.

In 1872, on the discovery of the superior value of Ledger Bark in Java, Dr. van Gorkom (Cinch. Cult. p. 93) held with Moens the view that " the future must be sought for in *C. Ledgeriana*, that joined to it for the preparation of Quinine only *C. officinalis* could be noticed and for the production of 'druggists'' bark *C. succirubra* deserves the front rank," and it was decided that " all plants of every other variety were to be turned out of the nurseries."

In British India, of the species comprising the Grey barks, which were collected by Pritchett in the forests of Huanuco and Huamalies in N. Peru and introduced into Sikkim, Dr. King reported that " *Cinchona micrantha, C. peruviana* and *C. nitida* being poor in Quinine, the cultivation of these species is now no longer carried on," and that " *Cinchona Pahudiana** proved worthless, and its cultivation has long since been entirely abandoned " (King, Manual of Cinchona, Calcutta, 1876, p. 20).

**Quinine versus Cinchona Alkaloids.**

As the object of the Government of India from the outset has been to supply the people of India with a cheap febrifuge rather than to grow barks with a high quinine content, and as analyses showed that the Cinchona species under trial varied greatly in the proportions in which the various alkaloids were present, it soon became evident that the therapeutical value of the alkaloids other than quinine should be investigated. Accordingly Commissions were set up in the Bengal, Madras, and Bombay Presidencies in 1866.

The findings of the Bengal and Bombay Commissions were substantially the same as those of the Madras Commission, which were conveyed in a report from the Government of Madras to the Secretary of State for India, dated 25th March, 1867.

In this report (para. 8) it was stated " the main conclusion which the Members of the Commission have derived from the data before them is that the alkaloids hitherto but little valued in medicine, are scarcely, if at all, inferior as therapeutical agents to quinine," and the Secretary of State in the course of his reply dated 24th May, 1867, agreed that " This result is so important, with reference to the value of those Cinchona species now cultivated in the Government plantations which yield quinidine, chinchonidine, and chinchonine, that it should be made generally known. I have, therefore, directed copies of the report to be furnished to leading physicians and chemists in Great Britain and on the continent." The Medical Committee was by order of Her Majesty's Secretary of State for India supplied with the three alkaloids mentioned for these tests

*This was a new species originally introduced from Peru into Java (Dec. 1854) by M. Hasskarl, the leader of the Dutch expedition to South America (1853-1854) to collect seeds of *Calisaya*. Its cultivation for the same reason (see p. 11) was abandoned in Java in 1862.

from the manufactory of Messrs. Howard & Sons (Parliamentary Returns on East India Cinchona Cultivation, 9th Aug., 1870, pp. 108, 115).

This was a great step forward, but it was not for some time that adequate action could be taken to put these results into effect. This involved the study of cheap and efficient methods of alkaloid extraction and the establishment of Government factories in India. Thus it was not until 1875 that a febrifuge made from the mixed alkaloids of *C. succirubra*, after being tested by the medical service of Bengal and being found a satisfactory substitute for quinine, was manufactured in bulk at a cheap price.

In addition to the Commissions set up in the three Presidencies to investigate the therapeutical value of the Cinchona alkaloids, the Secretary of State for India in the same year (Sept. 1866) appointed Mr. John Broughton, an analytical chemist, " to conduct investigations in concert with the superintendent of chinchona plantations on the Neilgherry Hills." He proceeded to his station at Ootacamund, Madras, in December of the same year. At this period the Secretary of State for India, in his letter of appointment to Mr. Broughton, stated that " the oldest trees on the Neilgherries have now been planted out nearly 4 years, and the analyses of their barks which have been made by Mr. Howard prove that there is a very marked increase of the yield of febrifuge alkaloids under cultivation. The time has now come, therefore, when it is necessary to investigate the causes which regulate the yield of alkaloids from cultivated cinchona barks and to ascertain the preparation of the febrifuge which will combine cheapness with efficacy in the greatest degree " (Parliamentary Returns on East India Cinchona Cultivation, 9th August, 1870, pp. 3, 4).

A preparation called " Quinetum " was manufactured in Java (about 1872), for which only Red Bark (*C. succirubra*) was considered suitable; but this did not last long before the Dutch industry began to concentrate on the manufacture of Quinine from the bark of *C. Calisaya* var. *Ledgeriana* (Agric. Ledger No. 4, 1911, p. 104), although, as stated above, Red Bark was not altogether neglected, being recommended by Moens and van Gorkom for the production of " druggists' bark."

Dr. De Vrij, who was Quinologist to the Dutch Government in Java from 1857 to 1863, proposed the name " Quinetum " for the mixed alkaloids of " Red Bark " after his retirement in 1863 from Java. He continued his work on the Cinchona alkaloids in Holland and in a letter dated The Hague, October 30th, 1872, to the Secretary of State for India, strongly recommended the preparation, as a febrifuge medicine, of the mixed alkaloids of " Red Bark " (*C. succirubra*) grown on the Sikkim plantation. Following this a Quinologist (Mr. C. H. Wood) was appointed for service on the Government plantations in Sikkim. Mr Wood was selected by the Secretary of State for India for this important post in May, 1873, and arrived

in October of the same year at Rungbee to take up his duties (Parliamentary Returns on East India Cinchona Cultivation, 21 March, 1876, p. 126).

The factory output of " Sikkim ' Quinetum ' " began in 1875 at 48 lbs., increasing to 7,007 lbs. in 1879. During this year " 128,000 ounces of this product were disposed of. This, at 1 rupee an ounce, cost £12,800, the same quantity of quinine at 12s. od. an ounce (its present price) would have cost £76,800, a clear saving of £64,000 " (Markham, Peruvian Bark, 1860-1880, p. 432). According to the report of the Government Cinchona Plantations in Bengal, 1921–22 (p. 2), " from 1875 to 1887 this was the sole product manufactured, reaching its greatest output in 1881-82 when nearly 11,000 lbs. were issued."

Owing, however, to the growing preference for quinine by the medical profession, the sale of Cinchona febrifuge had fallen in 1913 to about 1,600 lbs., and consequently there was a reduction in the area of cultivation of *C. succirubra* and an increase in that of *C. Calisaya* var. *Ledgeriana*, and, the report continues, " From 1903 the small demand that still existed for cinchona febrifuge was met by utilising the residue of mixed alkaloids, including a proportion of quinine, left after the extraction of quinine from *C. Ledgeriana.* A small acreage of *C. succirubra*, at present amounting almost to 90 acres, has however all along been kept in cultivation, so as to ensure the possibility of its cultivation being extended when the merits of its mixed alkaloids were rediscovered by the medical profession in general " (l.c.). Following the researches of Major Acton, I.M.S., into the chemistry and therapeutics of Cinchona febrifuge and quinine, which confirmed the conclusions recorded above, " The average annual sale of cinchona febrifuge for the last five years [1917-22] is almost 14,190 lbs. or eight times as much as in 1912-13, and much in excess of the maximum ever issued when it was the sole factory product " (l.c.) and an extension of the cultivation of *C. succirubra* again became advisable.

A Cinchona febrifuge under the name " Malarene " has recently appeared for use in India with some promising results, as indicated by the following extract from Adm. Report, Cinchona Dept., Govt. of Madras, 1923-24, p. 2.

" Noteworthy in the year is the success which the standardised preparation of Cinchona febrifuge—to which the name " Malarene " has been given—has obtained. Trials were made in various hospitals in the Presidency under the control of the Surgeon-General and the report of that officer indicates that for certain forms of Malaria this drug is most efficacious. In some districts so surprisingly good have the results been that ' Malarene ' has all but ousted quinine from pride of place. Efforts are being directed to augment the production of ' Malarene ' which is fortunately obtainable from Cinchona bark more easily grown than the quinine-yielding species—*Ledgeriana.*"

The composition of Cinchona febrifuge mixtures with special reference to their Quinidine content is discussed in a paper in the Pharmaceutical Journal, July 28th, 1923, pp. 91-93, by Bernard F. Howard and Oliver Chick, and Mr. Howard has also given some important information on the alkaloids in " Some Notes on the Cinchona Industry " in a pamphlet published by The Institute of Chemistry of Great Britain and Ireland (London, 1931). After enumerating 30 constituent alkaloids isolated from natural Cinchona barks he considers there are " only four natural alkaloids of real commercial importance, viz. the laevo-rotatory Quinine and Cinchonidine and the dextro-rotatory Quinidine and Cinchonine. The two amorphous substances, Quinicine and Cinchonicine, are also of some interest in that they are contained in considerable proportions in various types of febrifuges sold on the Indian Market."

In the Quarterly Journal of Pharmacy (No. 2, pp. 186-188, 1929) Dr. David Hooper, Quinologist to the Government of Madras (1884-97), contributes a paper on " The Standardisation of Cinchona Febrifuge." Comparing this with the Official Sulphate of Quinine he states " compared with a salt of such purity one would hesitate to render official a mixture of five alkaloids the proportion of which depends upon the exigencies of the Cinchona plantations and the Quinine factories." Quoting from Gage (Trans. Roy. Soc. Trop. Med. 1925), he continues " By bark mixture on a sufficient scale and, in time, by selection of trees, a reasonably steady average of alkaloidal constituents could be assured," and concludes " If this policy is pursued and when a preparation containing a suitable and fixed proportion of alkaloids is on the market it will be possible to acknowledge it as an official medicine."

The question of Cinchona febrifuge is now receiving the attention of the Malaria Commission of the League of Nations* and the Medical Director has furnished to the Health Committee a report of a sub-committee which contains the conclusions at which they have arrived, and a preliminary note on the analysis of a new standard preparation to which the name of " Totaquina " has been given. This sub-committee propose that " Totaquina " should contain 70 per cent. of crystallising alkaloids of which not less than 15 per cent. must be quinine. Amorphous alkaloids should not exceed 20 per cent., mineral matter not more than 5 per cent. and water not more than 5 per cent. The following resolution has been passed by the Health Committee of the League of Nations on this report :—The Health Committee, " Notes the conclusions of the sub-committee of pharmacological and chemical experts on the new preparation ' Totaquina.' Requests the Medical Director to arrange, with the Permanent Standards Commission, for the study of the chemical and biological control of this preparation to be continued. . . . These conclusions will be included in the report to be forwarded to the sanitary administrations concerned, which will deal with the

*CH/Malaria/167. (1) Geneva May 13th, 1931.

researches carried out under the auspices of the Malaria Commission in regard to the secondary alkaloids and mixtures of the alkaloids of Cinchona."

Recent medical research has been directed towards the use of a new drug called Beprochin. This preparation is now called " Plasmoquine " (a derivative of quinoline), supplied as " Plasmoquine brand of beprochin "—issued in tablets each containing 0·02 gm. (Plasmoquine Simplex). " Plasmoquine " compound is stated to contain 0·01 gm. of " Plasmoquine " and 0·125 gm. of quinine sulphate in each tablet. The compound tablets are considered the best to use, as the continuous treatment with plasmoquine alone is liable to produce cyanosis. Experiments with this proprietary medicine have been made under the direction of the Medical Officer of Health and Adviser on Tropical Diseases to the Ministry of Health on the prevention of Malaria with " Plasmoquine," and as reported in " The Lancet " (Aug. 15th, 1931, p. 341) it is claimed that " ' plasmoquine ' effectively prevents mosquito-borne malarial infection among a group of healthy individuals who take the prophylactic doses."

Whether this can be produced at a competitive price with Cinchona alkaloids is not certain, but in view of the present price of tablets of the above preparations it does not seem at all likely that they will displace the natural Cinchona alkaloids.

The importance of the Cinchona alkaloids is still being urged by various authorities. On June 4th, 1924, Sir David Prain gave a lecture at the Chelsea Physic Garden on " The Economic and Hygienic Relationship of Cinchona and its Alkaloids," discussing the alkaloid content of barks and the so-called Cinchona Monopoly in Java. As to the former the report in the Chemist and Druggist (June 14th, 1924, p. 827) leads one to infer that medical opinion seems to have undergone little change in attitude towards the use of quinine alone, and that full advantage is not yet taken of Cinchona and its alkaloids. Of the latter he said " this is no more than a quinine monopoly. That monopoly is not the creation of Java ; it is a consequence of the fact that yellow bark, which does not thrive in South India, grows better in Java than in any area outside Bolivia, where it has been tried. The preference of the planter everywhere for yellow bark is a result of the fact that the quinine maker pays a better price for that bark."

He gave similar evidence on the Quinine position at a meeting in London of the Royal Commission on Agriculture, in India, June 28th, 1927. The findings of the Commission are given in their report printed in Calcutta (1928), pp. 490-492, where it is stated (p. 490) " the annual total consumption of quinine in India is estimated at 160,000 lbs. of which only 42,000 lbs. are manufactured in the country. In these circumstances the Indian price is determined by the world price and this, as is well-known, is a monopoly price owing to the fact that ninety per cent. of the world's surplus [supply?] of quinine comes from Java.

" If India is to embark on any large campaign for fighting malaria we are convinced that it will first be necessary to reduce considerably the price of Quinine within India and this can only be effected if India is self supporting in production. To achieve this self sufficiency a considerable extension of the present area under Cinchona will be required."

Dr. Cowan in the Empire Forestry Journal, 1929, p. 48, quoting from Sir Patrick Hehir's recent book on " Malaria in India," states that " for India alone, the lowest amount of quinine which would have any effect upon the malaria problem would be about 970,000 lbs. This estimate is based on a consumption of only 20 grains per head per annum. . . .

" The total consumption in India is about one-sixth of this figure, so that, were India to be in a position to provide for her own minimum requirements she would immediately have to increase her production by eighteen times."

**The Importance of the Introduction of Ledgeriana to the Two Issues—Bark Production and Quinine Separation.**

This has influenced the cultivation throughout. The position of Cinchona cultivation in India about the time (1865-75) when *Ledgeriana* proved so successful in Java was that Red Bark (*C. succirubra*) and Crown or Pale Bark (*C. officinalis*) were the only two species amongst those introduced that proved suitable to the conditions in the Nilgiris. Greater attention was here paid to Red Bark, not only because it was more easily grown, but also for the reason that the mixed alkaloid content was the highest and likely to meet, as already stated, the demand for Cinchona febrifuge. Crown Bark was found to thrive well and was the main source of Quinine in Madras since *Calisaya* or Yellow Bark could not be successfully grown in the Nilgiris. " In 1886 the Nilgiri plantations contained about a million and a half plants of all ages of which 40,000 were in permanent plantations." (King, Manual, Cinchona, p. 19).

In Sikkim (N. India) Red Bark succeeded as well as, if not better than, in the Nilgiris ; but the position with regard to Crown Bark and Yellow Bark was reversed. In the northern plantation Crown Bark did not thrive so well, but Yellow Bark could be grown more successfully, though it did not yield so high a percentage of quinine as could be obtained in Java. Dr. King reported (Manual, Cinchona, p. 19) that " propagation by cuttings of *C. succirubra* and *C. officinalis* went on vigorously during succeeding years. It gradually, however, became apparent that *officinalis* does not thrive in Sikkim, and, after about 400,000 plants had been put out, all further planting of this species was discontinued, and not only so, but three-fourths of the area covered by it were replanted with *succirubra*. Only 125,000 plants of *officinalis* are therefore now

returned. Of *C. succirubra* there were on the 1st April 1875, 2,390,000 trees.

" The best of all the medicinal Cinchonas—namely *Calisaya* or Yellow Bark—promises to do well in Sikkim, and there were on the plantation on 1st April, 1875, 354,500 trees of that species, besides young plants in the nurseries."

" The great preponderance of *succirubra* trees in the plantation is not due to a preference for that species over *Calisaya*, but to the fact that the Red Bark tree is hardier . . .and has a much wider range, as regards conditions of growth, than *Calisaya*. Owing to the backwardness of *Calisaya* to yield seed, propagation by artificial methods had to be relied on until 1874. During that year the *Calisaya* trees for the first time seeded freely ; it was therefore hoped that the rapid extension of this species by seedlings could then be begun. But Mr. Wood, the recently appointed Quinologist, found considerable variation in yield from the bark of the different varieties, of which the best were selected and propagated by cuttings."

It was pointed out that whereas certain of these varieties yielded a bark containing as much as $7\frac{1}{2}$ per cent. of total alkaloid, of which nearly the whole was quinine, others yielded as little as $1\frac{1}{2}$ per cent. of total alkaloid. The best varieties yielded from $5\frac{7}{8}$-$7\frac{1}{2}$ per cent. of total alkaloid.

Incidentally it is interesting to compare, on Dr. King's authority (Manual, Cinchona, p. 7), the situation in Java at the same period. He states " At the end of the year 1860, the stock in the Java plantations consisted of nearly a million plants of *Cinchona Pahudiana*, with only about 7,000 of *Calisaya*. Having discovered the worthlessness of *Pahudiana*, the Dutch, in 1862, abandoned its cultivation. They also gave up (in 1864) the plan of planting out under forest shade. They have in recent years repeatedly got supplies of seed and plants of the best medicinal sorts from India and Ceylon, and their success of late has been great. According to the latest return (31st March 1875) there are in the Java plantations about two millions of Cinchonas of various ages. At least half of these are of undoubtedly valuable species, and amongst them are a hundred thousand of a variety of *Calisaya*, samples of the bark of some trees of which are said to have yielded on analysis the astonishing amount of from 10 to $13\frac{1}{4}$ per cent. of Crystalline Sulphate of Quinine." In a footnote to this King adds " This wonderful variety of *Calisaya* having been originally raised from seeds collected by Mr. Ledger, has been called by the Dutch *C. Calisaya, variety Ledgeriana*."

## Present Day Production.

**Bengal.**—The following information is obtained from the Annual Reports of the Government Cinchona Plantations, Bengal, for 1928-30 and will give some idea of the actual production of bark, quinine and cinchona febrifuge.

The quantity of Bengal bark harvested in the year 1928-29 was 465 tons (1,041,827 lbs.) at which period 2986 acres were under cultivation. Of this area 2306 acres were under *C. Calisaya* var. *Ledgeriana*, 275 under *C. succirubra*, 62 under *C. officinalis*, and of hybrids, 96 under *Ledgeriana* × *officinalis* and 245 under *Ledgeriana* × *succirubra*.

In 1929-30 the quantity of Bengal bark harvested was 1,130,402 lbs. and 1,060,656 lbs. were put through the factory. This latter amount was comprised of 950,458 lbs. of *Ledgeriana*, 22,509 lbs. of *succirubra*, 7188 lbs. of *officinalis* and 80,501 lbs. of " hybrid." From this were manufactured approximately 13,000 lbs. of purified sulphate of quinine and 20,078 lbs. of Cinchona febrifuge.

**Madras.**—According to a recent estimate (Report of the Government Cinchona Department, Madras, for 1928-29), the Cinchona plantations cover an area of 1858 acres, of which 1105 acres are in the Nilgiris and 753 acres in the Anaimalais, the latter being still quite young. This report states that " as recently as 1922 the general average quinine content of Naduvattam [plantation] bark worked out at 2·18 per cent. due admittedly to the Succirubra character of the hybrid tree then extensively planted. In the past year the average is over 100 per cent. above this figure—namely 4·68 per cent. and represents the best results of any year in the history of the plantations. Considering that Ledgeriana will not grow on the main plantation at Naduvattam, it is gratifying to possess Officinalis and Robusta capable of giving such a high outturn of quinine." It is interesting to note the records here that " in the lower part of Naduvattam, termed Moyar, analysis has revealed the presence of some very high grade Ledgeriana and seed from the trees has been reserved for the Anaimalai plantation " (*see* reference below) and that " surprisingly high analyses have been obtained from selected trees of Cinchona Officinalis, seed of which was obtained over forty years ago from Jamaica."

From the Nilgiri plantations 194,299 lbs. of bark were harvested in the year under review.

The plantations on the Anaimalai hills appear to have been started about 5 years ago and, in addition to the 753 acres in the permanent areas above mentioned, the nursery stock on 1st April, 1929, included 1,152,569 plants of *Cinchona Calisaya* var. *Ledgeriana*. It is interesting to note this development of *Ledgeriana* in this part of Madras as all previous records show that this variety has never succeeded in the older plantations in the Nilgiris.

Under " Factory Working " it is stated that " the Madras plantations are mostly immature, and were all available bark harvested now, there is not a sufficiency to keep the factory working for more than two to three years," and " one of the main problems of maintaining the factory at an economic level of outturn is the supply of bark."

" The Government of India have assisted the Madras Factory during the past five years with imported bark and thus the production has been maintained at an economic figure."

**Java.**—In 1927 the number of estates submitting returns in the Dutch East Indies was 138 with 19,656 hectares planted and 14,594 hectares in bearing, the production of bark being 12,692 tons (Report, Commercial Agent, Batavia, 1929, p. 80). Assuming this to be all *Ledgeriana*, on the average of the standard 7 per cent., the yield of quinine would be nearly 900 tons.

Howard in 1931 has estimated that " the actual world's consumption of quinine to-day is approximately 600 tons per annum."

## Species and Varieties of Cinchona at present under Cultivation.

By trial and selection there remained in use when Ledger bark came into prominence the following species and varieties.

*Cinchona Calisaya* Wedd. var. *Ledgeriana* Howard in Quin. E. Indian Plantations (1876) p. 86 [*C. Ledgeriana* Moens. ex Trimen, Journ. Bot. xix (1881) p. 323]. Ledger Bark, Yellow or Calisaya Bark. Native of Bolivia. Cultivated in Java, India, Tanganyika, Cameroons, etc. ; thrives in Java (lat. 7° S.) at an altitude of 3500 to 6000 ft. Amount of total alkaloid in the bark (Java) 5 to 10 per cent., and of quinine in " Commercial Ledger bark " 3 to 8 per cent.

*C. Calisaya* Wedd. in Ann. Sc. Nat. Ser. iii. x. (1848) p. 6. Yellow Bark, Calisaya Bark. Native of Bolivia—wild and cultivated—and S. Peru. A very variable species difficult to cultivate. Grown in India, Java, Cameroons, etc. ; succeeds at elevations of from 1500 to 3000 feet in Sikkim (lat. 27°N.). Calisaya quills yield 6 to 7 per cent. of total alkaloid ; 3 to 4 per cent. (in Bolivian cultivated) quinine.

*C. succirubra* Pavon ex Klotzsch in Abh. Akad. Berlin (1857) p. 60. [*C. pubescens* Vahl]. Red Bark. Native of Ecuador (known at the time of the Spanish occupation as a province of Peru). Cultivated in India, Burma, Java, Ceylon, Jamaica, St. Thomas (W. Africa), Tanganyika, Cameroons ; succeeds at altitudes of from 3000 to 6000 feet. The hardiest of all the Cinchonas, " Red Bark quills " average 6·5 per cent. (India) and 8·25 per cent. (Java) of total alkaloid ; and 1·5 (India) and upwards of 5 per cent. (Java) of quinine.

*C. officinalis* Linn. Syst. ed. x. (1759) p. 929. [*C. condaminea* L.]. Crown Bark, Loxa, Pale or Peruvian Bark are names by which this bark has been known in the trade since its introduction (1630) ; " Countess Powder " and " Jesuit's Bark " are also names by which it was originally known, but these have long since gone out of use, the latter continuing to about 1834. The author of the figure in the Botanical Magazine t. 6364 (1863) calls it " La Condamine's Peruvian Bark." Native of Ecuador, also in Colombia, Peru and Bolivia. Cultivated in S. India, Ceylon, etc. ; thrives at higher elevations

(6000 to 8500 ft. in the Nilgiris, lat. 11°-12° N.) better than any other of the species. " Pale Bark " quills average 6 per cent. total alkaloids and 3 per cent. (cultivated) of quinine.

All the above species are described in Kew Bull. Add. Series ix. pp. 349-352 where some general information is also given."*

There are two hybrids worthy of mention—" Ledger Hybrid " (*Ledgeriana* × *succirubra*) and *C. robusta* (*officinalis* × *succirubra*).

In Bengal " Ledger-Hybrid " has been found to be inferior to *Ledgeriana* in yield of quinine but it is of more robust habit and can be cultivated in parts where pure Ledger does not do so well. Only a small proportion of the total acreage is under this hybrid in India (Ann. Rep. 1921-22 Bengal p. 1). It was at one time extensively grown in Java, grafted on to *C. succirubra*, but it is reported to be going out of cultivation (Sands, Malay Agric. Journ. vol. x, No. 3, 1922).

The Hybrid *C. robusta* also appears to be now comparatively unimportant in India and Java—where it has been known since about 1881.

Both hybrids are in cultivation at Amani where Ledger-Hybrid has been found to yield from four year old trees over 6 per cent. of quinine, and one sample of bark examined at the Imperial Institute contained 11·30 per cent. of total alkaloid and 8·41 per cent. of quinine, and was therefore of very good quality (Report on Cinchona Bark, Imp. Inst. 1922, pp. 34-35). A sample of *robusta* bark from the same source was found to contain 7·61 per cent. of total alkaloid and 2·66 per cent. quinine—these percentages being considered high, as this bark generally contains 5 to 6 per cent. of total alkaloid and 2 per cent. of quinine.

It will be seen that in all the species of *Cinchona* known, there are comparatively few worthy of cultivation and that at the present time they are practically reduced to two—*C. Calisaya* var. *Ledgeriana* and *C. succirubra*, the one for the production of quinine and the other for the production of " druggists' bark " for official use and in the preparation of Cinchona febrifuge for local use. The latter species—

*The elevations given above are adapted briefly from King (Manual of Cinchona) and Watt (Commercial Products of India).

The climate at certain altitudes may vary according to latitude but as the best situations for growing Cinchona are chiefly in the Tropics, the differences are not important. Within these limits, however, winds and exposure are more serious in their effects, hence the usual recommendation to plant on the slopes of mountain valleys.

On the Nilgiris in India it was found by McIvor that " In standing the violence of storms, the ' Crown barks ' rank first, the ' Red ' second, the ' Grey ' third and the ' Yellow ' fourth " (*see* King, l.c. p. 28).

The success in the cultivation in Java would seem to be largely due to the selection of land at a suitable height above sea level, on the slopes of extinct volcanos and on intermediate plateaux, where the soil, of volcanic origin, is porous and open in character, enriched with humus (Malayan Agric. Journ. March 1922 and June 1931).

The total alkaloid and quinine content are quoted from Greenish (Materia Medica, 1929 ed.).

owing to its vigorous growth under varying conditions of soil and altitude—is now often recommended as a stock on which to graft good strains of the former species.

In Java—where as already stated *Ledgeriana* has long been the only source of bark for quinine production—according to W. N. Sands who visited the Island in January 1922 for the purpose of studying the industry as carried on there, the *Ledgeriana* types can only be successfully grown on their own roots in virgin land, of which there is a very limited area now available. Practically all the fields when replanted are put under selected *Ledgeriana* strains grafted on *C. succirubra* which for the production of bark is grown on a few estates where the elevation and land are not as a rule suitable for *Ledgeriana*. "On all large estates it is extensively sown to produce seedlings for grafting purposes only."

The cultivation is well understood in India and Java, the only countries producing bark on a commercial scale outside of South America.

At the present time the slow, laborious and costly methods employed in the early days, of "mossing," "shaving," and "coppicing" of the trunks of trees about eight years old, when harvesting the bark, are giving way to a rotation system of thinning out or pruning, beginning about the fourth year, and final uprooting when the tree has reached an age—approximately ten years—at which the maximum yield of alkaloid may be obtained from the roots, stems and branches : the land being afterwards replanted.

**Evidence of the Need for Expansion of Cultivation and of the Suitability of Different Parts of the Empire to this Cultivation.**

The findings of Commissions, the conclusions come to by various Committees and the researches of medical and botanical specialists on the subject of Cinchona, all afford evidence that there is good scope for increased production. The most promising countries, other than Bengal and Southern India, in the British Empire are those where it has already been proved by production of bark on a commercial scale including Burma, Ceylon, and Jamaica. Also there are in the Museum at Kew samples of bark obtained by trial cultivation which indicate the possibilities of development in parts of Tanganyika and British Cameroons.

The Amani samples submitted for report to the Imperial Institute (*see* Bull. Imp. Inst. 1918, pp. 386-388 and 1920, pp. 22-25, and Indian Trade Enquiry Report on Cinchona Bark 1922, pp. 34, 37) included *Cinchona Calisaya* var. *Ledgeriana, succirubra, robusta* and Hybrid (*Ledgeriana* × *succirubra*), all of which were found to be of good quality, equal to Java. Those from the British Cameroons were not named—though of the samples (No. 1, 2, 3, 4) submitted, the results showed that all were of good quality "furnishing from 6·7 to 8·2 per cent. of quinine sulphate and consignments of similar

quality would be very suitable for the manufacture of quinine sulphate." It was suggested that samples, 1, 2 and 3 were probably derived from the " Ledger-type " of Cinchona while sample 4 was probably derived from a " hybrid." The barks came from Buea (3300 feet alt.) where (August 1930), according to Mr. Maitland the present Superintendent, Botanic Gardens, Victoria, the species growing and in existence prior to the war were *succirubra*, *Ledgeriana* and *Calisaya*. Specially selected seed from Java of *succirubra* and *Ledgeriana* had recently been received and established at Buea for seed purposes.

Experiments are being made in British Malaya where, according to a report of the Department of Agriculture for the half-year ended June 30, 1930, *Cinchona Calisaya* var. *Ledgeriana* and *C. succirubra* under cultivation at the Experimental Plantation, Cameron's Highlands (4750 feet alt.), have shown good growth. Prepared samples of bark from both species had been sent to the Quinologist, Calcutta, for analysis and report on the Alkaloidal Content (Bull. Imp. Inst. 1930, p. 509).

Extensive private Cinchona plantations at one time existed in Ceylon (1872) to 1883* and S. India, chiefly under Crown Bark (*Cinchona officinalis*) and Red Bark (*C. succirubra*) ; but they could not compete successfully with the production of Yellow Bark (*C. Calisaya* var. *Ledgeriana*) in Java, owing to overproduction and the price on the market for Crown Bark being so much less than that obtained for Yellow Bark from Java. The planters then neglected Cinchona and planted Tea and other plantation crops which were found more profitable.

The Cinchona industry has little or nothing to fear in competition with the original sources in South America. Twenty-five years ago it was stated that " the once flourishing business in Peruvian bark is now almost entirely superseded by the cultivated barks from the East Indies. On an average only 60 to 70 tons are shipped yearly as compared with 500 tons to 800 tons in previous years " (Cons. Rep. Ecuador, 1906).

In 1927 out of a total of 812 tons—still called " Peruvian bark " in the Customs returns—from all sources imported into the United Kingdom, Java contributed 550 tons, British India 53 tons, other British countries 10 tons, and Peru 43 tons : whilst in 1928 and 1929 only about 20 tons in each year were imported into this country from Peru.

The synthetic production of Cinchona alkaloids also seems to be as far off as ever, Howard (Cinchona Industry, 1931) quoting his father's remarks of 1906—which appear to be equally true to-day,

*In Ceylon the cultivation began about 1870 ; it " rose from 500 acres in 1872 to 64,000 acres in 1883, the export of bark at its maximum (1887) being nearly 16,000,000 lbs." In 1909 there was only 156,081 lbs. of bark exported (Macmillan, Tropical Gardening and Planting, p. 420). In 1915 the exports of bark had fallen to about 20,000 lbs. and at the present time there are no records of any export.

states " The synthesis of quinine has always been hitherto an unattainable aim. It has been frequently attempted . . . and used to have a pecuniary as well as scientific attraction, but, from the commercial standpoint, can we hope to beat nature with her synthesis of 10 per cent. Ledgeriana ? " The further discussion of this question does not appear to be of serious import.

The main purpose of this paper will have been served in presenting a few facts from which it is hoped satisfactory conclusions can be drawn, more especially in the right selection of species of *Cinchona* to meet the modern demands of the grower, the manufacturers and the users.

There is an extensive literature on *Cinchona* from all points of view, including several books, but the following are recent references on the botany and cultivation.

" Cinchona " in Comm. Prod. India, Sir G. Watt, pp. 302-310 (John Murray, London, 1908).

" Cinchona in Java from 1872 to 1907," D. Hooper, in Agric. Ledger, No. 4, 1911, pp. 35-106, being extracts translated from the " Scheikundige Bijdragen Tot de Kennis der Java-Kina " by the late K. W. van Gorkom, published 1908.

Annual Reports of the Government Cinchona Plantations and Factory in Bengal—the 68th year 1929-30.

" The Cinchona (Quinine) Industry in Java," W. N. Sands, in the Malayan Agricultural Journal, Vol. x, No. 3, 1922 (Reprinted in the Tropical Agriculturist (Ceylon) Dec. 1922. pp. 352-370).

Report by the Imperial Institute on Cinchona Bark grown in India, St. Helena, East Africa and the Cameroons (Indian Trade Enquiry Series), 1922, pp. 1-40.

Malaria and Quinine (Amsterdam-Bureau for Increasing the use of Quinine) pp. 1-58 : illustrated (Amsterdam 1927).

" Cinchona in the Empire : Progress and Prospects of its Cultivation," Dr. J. M. Cowan, in " Empire Forestry Journal " Vol. 8, No. 1, 1929, pp. 45-53.

" The Standardisation of Cinchona Febrifuge," Dr. David Hooper, in Quarterly Journal of Pharmacy, Vol. 2, No. 2, 1929, pp. 186-188.

" Some Notes on the Cinchona Industry," Bernard F. Howard, pp. 1-22 (issued by the Institute of Chemistry of Great Britain and Ireland, London, 1931).

" The Rubiaceae of Ecuador," Paul C. Standley, Field Museum of Natural History, Chicago. Publication 285. Botanical Series, Vol. vii, No. 2, 1931, pp. 188-200.

" Cinchona culture in Java, its History and present Situation." Lecture by Dr. M. Kerbosch at the Missouri Botanical Garden, St. Louis. Reprinted from *De Bergcultures*, No. 18, May 2, 1931, in The Tropical Agriculturist (Ceylon), Vol. lxxvii, pp. 277-304.

" The genus Cinchona in Bolivia," H. H. Rusby, in Bull. Torrey Bot. Club, Vol. 58, No. 9, p. 523, 1931.

## II.—CONTRIBUTIONS TO THE FLORA OF TROPICAL AMERICA: IX.* T. A. Sprague and N. Y. Sandwith.

### The Tabebuias of British Guiana and Trinidad.

The genus *Tabebuia* Gomes (Bignoniaceae) is here understood almost in the same sense as in Bentham and Hooker's Genera Plantarum, but as including also the genus *Couralia* Splitg. which seems to differ in nothing but the opaque corky wings of the seeds. It thus includes, in addition to the typical simple-leaved species, the trifoliolate and quinquefoliolate ones referred by K. Schumann to a separate genus, for which he adopted the name *Tecoma* Juss. sensu Seem. The synonymy of the genus is therefore as follows :—

**Tabebuia** *Gomes*, Obs. Bot. ii. 7, t. 2 (1803) ; Benth. et Hook. f. Gen. Pl. ii. 1042 (1876).

*Tecoma* Juss. Gen. 139 (1789), partim ; Seem. in Journ. Bot. 1863, 19 ; K. Schum. in Engl. & Prantl, Nat. Pflanzenf. iv. 3b, 236 (1894) ; Bur. et K. Schum. in Mart. Fl. Bras. viii. pars 2, 315 (1897).

*Couralia* Splitg. in Hoeven & de Vriese, Tijdschr. Nat. Gesch. Phys. ix. 14 (1842) ; Benth. et Hook. f. l.c. ; K. Schum., l.c. 238 ; Bur. et K. Schum. l.c. 345.

Rehder (Mitteil. Deutsch. Dendr. Ges. 1913, 262) accepted the genus *Tabebuia* in the same sense as Bentham and Hooker, and showed that the name *Tecoma* Juss. (1789), which originally covered species of three genera, namely, *Stenolobium* D. Don, *Campsis* Lour. and *Tabebuia* Gomes, should properly be applied to *Stenolobium*. These conclusions were accepted by Urban (Fedde, Repert. xiv. 304-306 : 1916). Schumann himself had admitted that the only character separating *Tabebuia* from *Tecoma* (sensu Seem.) was the simple leaves, and if this character is accorded generic value, it separates species which have in other respects much in common. This is well illustrated by the series (1) *T. cassinoides*, (2) *obtusifolia*, (3) *stenocalyx*, (4) *longipes*, (5) *roraimae*, (6) *dura*, which seems to form a very natural group. All have a lepidote calyx. The first three species have simple leaves, and the last two have 3–5-foliolate leaves, while those of *T. longipes* are intermediate in type, being 1-foliolate, with the lamina articulate to the petiole. As far as the sum total of their morphological characters is concerned, species (5) and (6) are certainly nearer (1) and (2) than they are to the 3–5-foliolate species of "*Tecoma*" (sensu Seem.) with a stellately tomentose calyx, such as *T. serratifolia* (*T. araliacea*) or *T. Avellanedae* (*T. Ipe*). The nature of the indumentum seems to be of far greater importance than the number of leaflets. And if two genera are recognised, to which should *T. longipes* be assigned, to *Tabebuia* on account of its single lamina, or to "*Tecoma*" because of the presence of an articulation at the apex of the petiole, indicating that the leaf is compound ?

*Continued from *K.B.* 1931, p. 492.

Another series of species which seem to be closely related is represented by (1) *T. lepidota* (5–3-foliolate), (2) *T. trachycarpa* (simple-leaved) and (3) *petrophila* (leaves usually simple, a single unequally 2-foliolate one seen). These are all native of Cuba and agree in the possession of short shoots, lepidote leaves and calyces, and corollas glabrous outside, purple in *T. lepidota* and *T. trachycarpa*, not known in *T. petrophila*. Here a very close relationship seems to subsist between *T. lepidota*, which has 5–3 leaflets, and *T. trachycarpa*, which has simple leaves, though according to Schumann's classification they should be assigned to separate genera.

The genus *Tabebuia* is of considerable economic importance as containing numerous species yielding valuable timbers (vide Record, Timbers of Tropical America, pp. 532-544). Among those included in the present paper are the "Black Poui" of Trinidad, or "Cogwood" of Tobago (*T. rufescens*), the "Hakkea" or "Hackia" of sandy soil in British Guiana (*T. hypolepra*, sp. nov.) and the "Yellow Poui" of Trinidad or "Washiba" of British Guiana (*T. serratifolia*).

The species of *Tabebuia* have not been adequately studied hitherto, and some of those yielding important timbers have not yet been identified, owing to absence of corresponding herbarium material. As the result of the present investigation, the three important timber trees mentioned above have been critically determined, and it has been established that *T. glomerata* is a synonym of the previously described *T. rufescens*, and that *T. araliacea* of Brazil is synonymous with *T. serratifolia* of the West Indies and Venezuela. Up to the present these have been treated respectively as independent species in all botanical works.

### Key to the British Guiana and Trinidad Species.

Calyx lepidote outside : corolla white :

Leaves simple or 1-foliolate :

Lamina not articulated to petiole ; calyx elongate-tubular ; corolla-tube narrowly cylindric in the lower two thirds, narrowly funnel-shaped above, with dense groups of plate-shaped glands outside below the lobes.....1. *stenocalyx.*

Lamina articulated to petiole, or petiole obviously thickened at apex ; calyx campanulate or tubular-campanulate ; corolla-tube funnel-shaped, without groups of glands below the lobes .....2. *longipes.*

Leaves 3–5-foliolate :

Leaflets oblong, elliptic-oblong or obovate, obtuse or rounded above, sometimes shortly apiculate, lateral nerves distinctly impressed above.....3. *roraimae.*

Leaflets ovate-oblong to narrowly lanceolate, acutely acuminate, lateral nerves slightly raised above :

Leaflets shining above, ultimate reticulation raised on lower surface ; terminal leaflet 9–13 cm. long, lateral nerves 6–9 on each side ; inflorescence lax.....4. *dura.*

Leaflets dull above, ultimate reticulation not raised on lower surface ; terminal leaflet 11–20 cm. long, lateral nerves 12–14 on each side ; inflorescence contracted...5. *aquatilis.*

Calyx stellate-pubescent or tomentellous outside ; corolla yellow (colour not known in *T. floccosa*) :

Leaves 5-foliolate ; flowers in terminal inflorescences ; calyx-lobes not subulate ; corolla glabrous outside ; disk sessile :

Calyx clothed outside with a persistent coarse or fine tomentum :

Leaflets pubescent with both simple and stellate hairs, rather densely lepidote on the lower surface ; calyx tomentose..... 6. *rufescens.*

Leaflets pubescent with stellate hairs only, sparingly and inconspicuously lepidote on the lower surface ; calyx tomentellous below, somewhat glabrescent above between the nerves.....7. *subtilis.*

Calyx clothed outside with a sparser and easily removable indumentum :

Finest veinlets on upper surface of leaflets raised, areoles impressed-punctate, lower surface densely lepidote ; calyx-lobes more or less ribbed outside.....8. *hypolepra.*

Finest veinlets on upper surface of leaflets slightly impressed or at any rate not raised, areoles flat or convex, usually not obviously impressed-punctate, lower surface sparingly lepidote ; calyx lobes not ribbed.....9. *serratifolia.*

Leaves 3-foliolate ; flowers solitary, terminal ; calyx-lobes subulate ; corolla subtomentose outside ; disk peltately attached.....10. *floccosa.*

1. **T. stenocalyx** *Sprague et Stapf* in Kew Bull. 1910, 196 ; Urb. in Fedde, Repert. xiv. 304 (1916).—*Schlegelia violacea* Griseb. Fl. Brit. W. Ind. 445 (1861), partim, excl. syn.

Trinidad. St. Anne, fl. April, *Crueger.* Near bungalow on Mt. Harris, Central Range Reserve, in poor soil, a smallish tree, fl. and fr. July, *Marshall in Trinidad Bot. Gard. Herb.* 12222. Government House Grounds, fl. Sept., *Broadway* 2888, fr. Aug., *Broadway.* Botanic Gardens, fl. and fr. March, *Trinidad Bot. Gard. Herb.* 3566.

British Guiana. Barama River, Pomeroon District, *im Thurn in Jenman* 1947.

Brazil. Specimen cultivated in Hort. Kew (Herb. Hook.).

As stated by Sprague and Stapf, l.c. the specimens from British Guiana and Brazil have proportionately narrower leaves with more numerous lateral nerves, but we cannot separate them specifically.

Mr. R. O. Williams informs us that *T. stenocalyx* is apparently a common plant in Trinidad, and mentions the following additional material in the Trinidad Herbarium : no. 12503, Quare Road, *Brooks* ; no. 11856, Sangre Grande, *Williams* ; Arima, *Dannouse.*

2. **T. longipes** *Baker* in Hook. Ic. Pl. t. 1738 (1888).

British Guiana. Hooroobea, in wet savannahs, fl. and fr. April, *Jenman* 3723. Upper Demerara River, fl. and fr. Sept., *Jenman* 4256. Lama, fl. April, *Jenman* 4700. N. W. District, Waini River, Tururebaru Creek, in swampy land inundated at high tide, *Brit. Guiana Forestry Dep.* 901. N. W. District, Barima River, *De La Cruz* 3377. Potaro River, Kaieteur Savannah, *Jenman* 830, 1064. Demerara, *Parker*. British Guiana, without locality, *Appun* 833. Guiana, labelled " Bignonia monophylla," *Herb. Forsyth.*

A tree, 8–20 m. high, known as " White Cedar " and furnishing a useful wood for indoor purposes. On the Upper Demerara River and on the Waini River it is known by the Arawak name " Warikuri " or " Warakuri."

The specimens from the Kaieteur Savannah have a somewhat different facies, the leaves being markedly areolate beneath, but we have been unable to separate them specifically. Possibly they may represent an edaphic form.

3. **T. roraimae** *Oliv.* in Trans. Linn. Soc. ser. 2, ii. 280, t. 45 (1887) ; N. E. Brown in Trans. Linn. Soc. ser. 2, vi. 57 (1901).—*Tecoma roraimae* K. Schum. in Engl. & Prantl, Nat. Pflanzenf. iv. 3b, 238 (1894). *Tabebuia triphylla* Klotzsch in Rich. Schomb. Reise, iii. 1085 (1848) ; Rich. Schomb. Travels, ed. Roth. ii. 209 (1923) ; non DC.

British Guiana. Southern slope of Roraima, at 1800 m., fl. Nov., Dec., *Rich. Schomburgk* 980 (*Rob. Schomburgk* 641). Roraima, 1500 m., fl. Dec., *im Thurn* 64. Roraima, on upper slopes, *McConnell and Quelch* 33. Roraima, 1600 m., fl. Dec., *Ule* 8761.

A small tree (3–10 m. high, according to Ule).

4. **T. dura** (*Bur. et K. Schum.*) *Sprague et Sandwith*, comb. nov.—*Tecoma dura* Bur. et K. Schum. in Engl. & Prantl, Nat. Pflanzenf. iv. 3b, 238 (1894). *Tabebuia fluviatilis* Klotzsch in Rich. Schomb. Reise, iii. 1085 (1848), non DC.

British Guiana. Roraima, on the southern slopes, *Rich. Schomburgk* 928 (*Rob. Schomburgk* 658). Edge of water and along cataracts, *Rob. Schomburgk.*

A tree (according to Rich. Schomb. l.c.).

5. **T. aquatilis** (*E. Mey.*) *Sprague et Sandwith*, comb. nov.—*Bignonia aquatilis* E. Mey. in Nov. Act. Nat. Cur. xii. 780 (1825). *Bignonia digitata* E. Mey. l.c.782 . *Bignonia fluviatilis* G. F. W. Meyer, Prim. Fl. Esseq. 212 (1818) ; an Aubl. partim ? *Couralia fluviatilis* Splitg. in Hoeven & de Vriese, Tijdschr. Nat. Gesch. Phys. ix. 15 (1842) ; K. Schum. in Mart. Fl. Bras. viii. pars 2, 347 (1897). *Zeyheria fluviatilis* Miq. in Flora 1842, xxv. 428. *Zeyheria digitata* Miq. l.c. 431. *Tabebuia fluviatilis* DC. in DC. Prodr. ix. 215 (1845). *Tecoma Meyeriana* DC. l.c. 221 ; Miq. Stirp. Surinam. Sel. 121, 122 (1850). *Tecoma fluviatilis* Miq. l.c. 121. *Tecoma insignis* Miq. l.c. 122, 123.

British Guiana. Lower Demerara River, fl. Dec., *Jenman* 4319, and fl. May, *Jenman* 4345. Bank of Corentyne River near Orealla, common in water by riverside, fl. Sept., Oct., *Jenman* 477 and *im Thurn*. Demerara, *Parker*. Demerara, *unknown collector*, 71 (Mus. Brit.).

Surinam. Paramaribo, fl. April, *Samuels* 51. Without locality, *Hostmann* 384, 1036; *Hostmann* sine numero in Herb. Goetting. (syntype of *Bignonia aquatilis* E. Mey.); *Kegel* sine numero in Herb. Goetting.

French Guiana. Without locality, *Aublet* (Mus. Brit.) *Mélinon* 65, 223 (Herb. Paris.), *Martin* (Herb. Paris.).

Brazil. Pará: Breves, Furo Macujabim, fl. Aug., *Guedes in Herb. Amaz. Mus. Pará* 2215 (Mus. Brit.).

A small tree or shrub (about 3 m. high, according to Jenman), apparently confined to river-banks. Vernacular names: "Hack-ooya," "Whoua-whoua" (Brit. Guiana); Courali (Surinam).

*Bignonia fluviatilis* Aubl. Hist. Pl. Guiane Franç. ii. 655, iv. t. 267 (1775) is a very doubtful plant based, according to Ernst Meyer and Splitgerber and Miquel, on material of two very different species. Aublet's general illustration and his fig. 1 (leaf) were identified with *Bignonia aquatilis* E. Mey. and *Couralia fluviatilis* Splitg. respectively by the authors of these species. E. Meyer described the leaflets of his *Bignonia aquatilis* as being rounded at the base, which agrees with Aublet's illustration, whereas Splitgerber described the leaflets of his *Couralia fluviatilis* as being acuminate or obtuse at the base (rounded in a specimen in Aublet's herbarium). On the other hand, a specimen from Aublet's herbarium named *Bignonia fluviatilis* in Herb. Mus. Brit. has the leaflets attenuate at the base. A specimen collected by Parker in Demerara (Herb. Kew) agrees with the description of *Bignonia aquatilis* E. Mey. and with Aublet's general illustration, but all the other specimens cited above have the leaflets more or less narrowed at the base.

The Surinam specimens of *Couralia fluviatilis* described by Splitgerber were stated by him to possess seeds with coriaceous wings, a character which led him to base the new genus *Couralia* on this species. Aublet, on the other hand, both described and figured the seeds of his *Bignonia fluviatilis* as having a membranous margin, possibly owing to a mixing of specimens.

Since the application of the name *Bignonia fluviatilis* Aubl. is so uncertain, we reject it and the later combination *Tabebuia fluviatilis* as nomina dubia, and adopt the specific epithet *aquatilis* proposed by E. Meyer.

6. **T. rufescens** *J. R. Johnston* in Proc. Amer. Acad. xl. 696 (1905); Urb. in Fedde, Repert. Sp. Nov. xiv. 305 (1916), in obs.—*Tecoma spectabilis* Griseb. Fl. Brit. W. Ind. 447 (1861), non Planch. *Tabebuia serratifolia* Rolfe in Kew Bull. 1893, 267, non (Vahl) Nichols. *Tabebuia glomerata* Urb. in Fedde Repert. Sp. Nov. xiv. 305 (1916);

R. C. Marshall, Sylvic. Notes Timber Trees Trinidad and Tobago, 40 (1930).

Colombia. Without locality, without flowers or fruit, *Triana* 362 (Mus. Brit.).

Venezuela. Margarita Island: San Juan Mountain, 500 m., fl. and fr. July, *J. R. Johnston* 79 (fragment of type in Herb. Berol.). Quebrada Sebucan, not uncommon, without flowers or fruit, *Ernst* 496 (Mus. Brit.).

Trinidad. Chacachacare Island, *Crueger* 257. Without locality, *Lockhart, Fendler* 527. Cultivated in Victoria Square, Port of Spain, fl. and fr. Febr., *Broadway* 5558. Cultivated in Queen's Park Hotel Yard, fl. March, *Britton* 2658. According to R. C. Marshall, l.c. this species tends to be found more in the south of the island and occurs rather on the heavier clay soils than on the sands.

Tobago. Rockley Vale, fr. Jan., *Broadway* 3637 (Mus. Brit.; Herb. Berol.). Botanic Station, *Broadway* 2989 (Mus. Brit.). In forests in the interior, near Frenchfield, 400 m., fl. and fr. Oct., *Eggers* 5532 (Herb. Berol.).

Grenada. Without locality, *Broadway* 1494 (Herb. Berol. ex Urb. l.c.).

St. Vincent. Forest near Lowman's Village, western spurs of Mt. St. Andrew's, 480 m. fl. May, *H. H. and G. W. Smith* 1652. Without locality, *Guilding*. Cultivated in the Botanic Garden, *Powell* 3.

Martinique. Introduced, *Hahn* 1449.

Jamaica. Cultivated in Hope Gardens, fl. Aug., *Harris* 30.

A small tree, attaining a height of 9–15 m., and furnishing a useful hardwood. Vernacular names: "Black Poui," "Poui Vert" (Trinidad); "Cogwood" (Tobago); "Poui," "Greenheart" (Grenada).

Urban (l.c.) separated his *Tabebuia glomerata* from *T. rufescens* J. R. Johnston (which was based on material with very young leaves), by the shape of the leaflets, length of the pedicels, and shape of the calyx-lobes. We are unable to distinguish two species on these characters. Cultivated specimens from Jamaica exhibit a considerable amount of variation in the shape of the leaflets, some being obovate, cuneate at the base, and others, belonging to the same collecting, elliptic, subcordate at the base.

Seedlings, and young trees of this species, have very coarsely serrate leaflets, whereas those of older trees are entire.

7. **T. subtilis** *Sprague et Sandwith*, sp. nov.; affinis *T. rufescenti* J. R. Johnston, a qua indumento subtiliore, foliolis pilis stellatis tantum pubescentibus, subtus sparse inconspicue lepidotis, calyce inferne tomentello superne inter nervos glabrescente differt.

*Arbor* parva, ramulis hornotinis foliiferis brevibus tenuibus ad 10 cm. longis ad 2 mm. diametro leviter applanatis sulcatis dense conspicue stellato-tomentellis, indumento subtili siccitate pallide ferrugineo. *Folia* quinato-digitata, raro ternata; petiolus foliorum

bene evolutorum 5–7 cm. longus, indumento ramulorum senectute detersili praeditus ; petioluli indumento simili, terminales 1·3–3 cm. longi, intermedii 1–2 cm. longi, inferiores vulgo 3–8 mm. longi ; foliola anguste lanceolata vel oblanceolata, vel oblongo-elliptica, apice sensim longe acutiuscule acuminata, acumine 0·5–2·5 cm. longo, basi cuneatim attenuata usque rotundata, terminalia saepius 5–14·5 cm. longa, 0·8–4 cm. lata, exteriora minora, integra, juniora membranacea, supra nigrescentia, subtus pallidiora, utrinque praesertim nervis dense stellato-pubescentia, nonnunquam subtus dense tomentosa glandulis nigrescentibus sessilibus patelliformibus hic illic praesertim secus nervum medium satis copiosis conspersa, adulta satis rigida, tenuiter coriacea, supra nitida conspicue laxe reticulata, costa stellato-pubescente ceterum glabra, dense impresso-punctata, subtus laxe reticulata dense stellato-pubescentia usque glabrescentia, nervis primariis utroque costae latere saepius 10–14 ascendenti-arcuatis prope marginem anastomosantibus. *Inflorescentiae* terminales, ex apice ramulorum annotinorum defoliatorum ortae, vel nudae vel ramulis axillaribus foliatis novellis consociatae, raro e ramulo annotino axillares, corymboso-thyrsoideae vel corymboso-racemosae, brevissimae, nonnunquam ramulos hornotinos foliatos terminantes, rhachi 0·6–2 cm. longa, rhachi pedicellis bracteis bracteolisque pilis stellatis dense ferrugineo-tomentellis ; bracteae lineari-subulatae, 0·5–2 cm. longae ; pedicelli vulgo 0·3–1 cm. longi ; bracteolae fere in medio pedicello vel infra positae, bracteis similes sed breviores. *Calyx* anguste campanulatus, lobis inclusis 1–1·7 cm. longus, apice tubi (statu applanato) circiter 1 cm. latus, saepe bilabiatus, labio altero breviter bilobo altero trilobo, lobis triangulari-ovatis saepe crasse apiculatis 1·5–5 mm. longis 2–6 mm. latis, conspicue costato-nervosus, extra inferne pilis ferrugineis dense stellato-tomentellus, supra inter nervos nigrescens sparsius indutus et glandulis nigris patelliformibus immersis hic illic conspersus. *Corolla* lutea, infundibularis, 6–9 cm. longa lobis inclusis, extra glabra vel superne, praecipue in venis, stellato-puberula ; lobi ad 2 cm. longi, ciliati ; tubus intus antice villosus, parte inferiore infra insertionem staminum villosa. *Stamina* longiora (antica) circiter 1·2 cm. supra basin corollae tubi inserta, filamentis 2·5 cm. longis basi villosis ; breviora (lateralia) circiter 0·9 cm. supra basin inserta, filamentis 2 cm. longis inferne (2·5 mm.) villosis ; antherarum thecae divaricatae, singulae 3 mm. longae. *Staminodium* circiter 0·8 cm. supra basin insertum, 1·2 cm. longum, glabrum. *Discus* breviter cupularis, vix 1 mm. altus. *Ovarium* lineari-oblongum, 6 mm. longum, minute sparse stellato-puberulum ; stylus circiter 3 cm. longus, breviter stellato-puberulus. *Ovula* circiter 8-seriata, seriebus singulis multiovulatis. *Capsula* elongato-linearis, superne attenuata, 45–50 cm. longa, infra medium ad 1·2 cm. lata, irregulariter costata et subtilius striata, pilis minutis ferrugineis stellatis subtiliter pubescens. *Semina* alis inclusis 2·5–4 cm. lata, nucleo 4–6 mm. longo, 1–1·8 cm. lato.

British Guiana. Mazaruni River : on rocks by waterside, Macreba Falls, Kurupung River, fl. and fr. Aug., *Altson* 353 (type). Potaro River : on rocks, Tumatumari Falls, fl. Sept., *Jenman* 7393 ; by riverside, Coobanatuk, fl. Oct., *Jenman* 7461 ; Pacatout Falls, fl. March, *Jenman* 5189.

According to Altson, *T. subtilis* is a small tree, common on rocks by the waterside, with most of the flowers borne on leafless branches. Calyx green, brown-tomentose, commonly punctured by (?) hummingbirds. Corolla yellow, easily falling. Vernacular name : " Arawing-yek " (Acawai).

8. **T. hypolepra** *Sprague et Sandwith*, sp. nov. ; affinis *T. serratifoliae* (Vahl) Nicholson, a qua venulis ultimis foliolorum supra elevatis areolis impresso-punctatis, pagina inferiore dense lepidota, calycis lobis extra plus minusve costatis differt.

*Arbor* excelsa, circiter 30 m. alta, 30 cm. diametro ; ramuli summi annotini crassi, lignosi, cinerei, glabrescentes ; hornotini pilis siccitate pallide ferrugineis dense furfuraceo-stellato-pubescentes. *Folia* quinato-digitata, raro ternata ; petiolus 2·5–8 cm. longus, juventute stellato-pubescens, mox glabrescens, costatus, supra inferne applanatus ceterum late canaliculatus ; petioluli similes, terminales 1·7–3·7 cm. longi, intermedii 1–2·5 cm. longi, inferiores vulgo 4–8 mm. longi ; foliola oblongo-lanceolata, lanceolata, oblonga vel obovato-oblonga, exteriora minora nonnunquam ovata, apice plus minusve conspicue breviter vel longe acuminata, basi saepius inaequilatera obtusa vel rotundata, terminalia 8·5–14·5 cm. longa, 2·8–5·2 cm. lata, exteriora minora, integra, tenuiter coriacea, supra nitidula, costa nervisque stellato-pubescentibus, mesophyllo glabrescente lepidibus impressis exceptis, intricatissime reticulata, venulis ultimis elevatis, areolis impressis lepidibus lapsis conspicue punctatis, subtus pallida subglaucescentia, epilosa axillis nervorum saepius foveolato-barbellatis exceptis, dense conspicue lepidota vel lepidibus delapsis punctata, reticulatione multo minus conspicua areolisque saepe sub lepidibus conditis, nervis lateralibus utroque costae latere saepius 10–12 ascendentibus rectiusculis parallelis tum marginem versus arcuato-anastomosantibus. *Inflorescentiae* in ramulis nudis vel foliatis terminales vel etiam axillares, brevissimae, umbellatae, stellato-tomentosae ; bracteae bracteolaeque ut videtur lineares brevissimae, maturae haud visae ; pedicelli breves, 1·5–5 mm. tantum longi. *Calyx* campanulatus, lobis inclusis 0·8–1·2 cm. longus, apice tubi (statu applanato) ad 8 mm. latus, irregulariter 5-lobus, lobis triangulari-ovatis saepius crasse apiculatis ad 4 mm. longis ad 5 mm. latis, saepius superne nervosus, extra satis dense stellato-pubescens, margine loborum membranaceo glabrescente. *Corolla* laete lutea, campanulato-infundibularis, lobis inclusis 6–7 cm. longa, tubi parte basali cylindrica 6–7 mm. longa, limbo 5–6·5 cm. lato, extra glabra ; lobi 2–3 cm. longi, sparse ciliati, intus inferne sparse villosuli ; tubus intus antice villosus, juxta insertionem staminum brevius villosus.

*Stamina* (sicut staminodium) circiter 4–6 mm. supra basin corollae tubi inserta, inferne dense breviter villosa ; longiora (antica) 1·5–1·9 cm. longa, breviora (lateralia) 1·2–1·3 cm. longa ; antherarum thecae divaricatae, singulae vix 3 mm. longae. *Staminodium* plus minusve curvatum, 5–8 mm. longum. *Discus* cupularis, vix 1 mm. altus. *Ovarium* leviter compressum, ambitu lanceolato-oblongum, 4 mm. longum, 1·5 mm. latum, densissime lepidotum ; stylus 2·5 cm. longus, ut videtur glaber. *Ovula* circiter 8-seriata, seriebus singulis multiovulatis. *Capsula* desideratur.

British Guiana. Essequibo River : Moraballi Creek, in Wallaba forest, on sandy ridge, fl. Nov., *Sandwith* 594 (type). Takewah Hill, fl. June, *Jenman* 6613. Potaro River : Tumatumari Falls, fl. Oct., *Jenman* 7437. Corentyne River, near Ulafenna River, *Brit. Guiana For. Dep.* 580A.

French Guiana. St. Jean, concession Bouvet, *Benoist* 1238 (Herb. Paris.).

The type-material from Moraballi Creek was from a large tree 30 m. high, 30 cm. in diameter. Flowers on old branchlets, separate from leaves, bright yellow, hairy within on anterior side of tube and throat, lobes very frilly-edged. Vernacular name : " Hakkea " (Arawak).

This species is mentioned by Record (Timbers of Tropical America, 540 : 1924) as the commonest species of " hackia " in British Guiana, having yellow flowers, and growing chiefly on sandy hills.

9. **T. serratifolia** (*Vahl*) *Nicholson* Dict. Gard. iv. 1 (1888) ; Urb. in Fedde, Repert. Sp. Nov. xiv. 305 (1916) ; R. C. Marshall, Sylvic. Notes, Timber Trees Trinidad and Tobago, 40 (1930).—*Bignonia serratifolia* Vahl Ecl. ii. 46 (1798). *Tecoma serratifolia* G. Don, Gen. Syst. iv. 224 (1838) ; Griseb. Fl. Brit. W. Ind. 447 (1861) ; Pittier, Pl. Usuales Venez. 203 (1926). *Bignonia flavescens* Vell. Fl. Flum. 252 (1825) ; Ic. vi. t. 51 (1827). *Tecoma flavescens* Mart. in DC. Prodr. ix. 216 (1845). *Bignonia araliacea* Cham. in Linnaea, vii. 683 (1832). *Tecoma araliacea* DC. in DC. Prodr. ix. 221 (1845) ; Bur. et K. Schum. in Mart. Fl. Bras. viii. pars 2, 328 (1897) ; Pulle, Enum. Vasc. Pl. Surinam, 428 (1906). *Tabebuia araliacea* Morong et Britton in Ann. N. Y. Acad. Sc. vii. 190 (1893), quoad syn. *Bignonia araliacea* Cham., excl. specim. et descr. *Tecoma speciosa* DC. in DC. Prodr. ix. 218 (1845). *Tecoma conspicua* DC. l.c. 221. *Bignonia conspicua* Rich. ex DC. l.c., pro syn. *Tecoma nigricans* Klotzsch in Rich. Schomb. Reise, iii. 1159 (1848), nomen.—*Guirapariba* Marcgr. Hist. Pl. 118, cum ic. (1648).

Colombia. Llanos de San Martin, without flowers or fruit, *Triana* 4114 (Mus. Brit.).

Venezuela. Provinces of Zulia, Lara, Portuguesa, Carabobo and Miranda (fide Pittier, l.c.) Zulia : Veras Altas, on the road from Maracaibo to Machiques, pretty frequent, fl. Oct., *Pittier* 10508.

ST. VINCENT. Without locality, *Guilding*.

TRINIDAD. Common in the northern range of mountains, *Lockhart* 198. Port-of-Spain: Queen's Park, fl. and fr. April, *Broadway* 4165; Hillside, fl. March, *Britton* 2629; Botanic Garden, fl. June, *Hart* 3695. Radix Point, Mayaro, fl. July, *Williams and Sampson in Herb. Trin.* 11739. Without locality, *Fendler* 524. According to R. C. Marshall, l.c., *T. serratifolia* is widely distributed throughout Trinidad, chiefly on poor soils.

BRITISH GUIANA. Essequibo River: Moraballi Creek, in morabukea—mixed forest, fl. Nov., *Sandwith* 612. Banks of the Takutu River, fl. April, May, *Rich. Schomburgk* 501 (*Rob. Schomburgk* 409). Savannah, *Pollard* 39.

SURINAM. Without locality, *Hostmann* 1055, *Focke*.

FRENCH GUIANA. Maroni, *Sagot* 1142. Charvein, *Benoist* 697 (Herb. Paris.). Without locality, *Poiteau*, *Aublet* (Mus. Brit.) *Martin* (Mus. Brit.).

BRAZIL. Pará: Tauaú, fl. Sept., *Spruce* 148. Pernambuco: Tapera, fl. Dec., *Pickel* 135 (Mus. Brit.). Also from Goyaz, Rio de Janeiro and S. Paulo (*vide* Bur. et K. Schum. l.c.).

BOLIVIA. Dep. Santa Cruz: Prov. Sara, in campos and woods, Buenavista, fl. Sept., *Steinbach* 6414, 7211.

Bureau and K. Schumann recorded this species from Paraguay on the authority of Morong and Britton in Ann. N.Y. Acad. Sc. vii. 190 (1893). Since Morong, however, stated that the corolla of his "*Tabebuia araliacea*" was bright purple, and white-downy outside, it was obviously not that species but *T. Avellanedae* Griseb., which is widely spread in Paraguay.

*T. serratifolia* is a tall tree, with smooth silvery bark, and attaining a height of 25–30 m. Vernacular names: "Poui," "Yellow Poui," "White Poui" (Trinidad); "Curarí," "Curariguo," "Curarire," "Coralibe," "Pui" (Venezuela, fide Pittier, l.c.); "Washiba" (British Guiana); "Groenhart" (Surinam, fide Pulle, l.c.); "Pao d'Arco" (Lower Amazons); "Ipé" (Brazil). According to Record (Timbers of Tropical America, 540: 1924), the "Washiba" of British Guiana [*T. serratifolia*] is similar to the common "Hackia" of sandy hills [*T. hypolepra*] but occupies the flat clay lands along streams, and consequently is of larger size and better timber form.

10. **T. floccosa** (*Klotsch ex Bur. et K. Schum.*) *Sprague et Sandwith*, comb. nov.—*Tecoma floccosa* Klotzsch in Rich. Schomburgk, Reise, iii. 971 (1848), nomen; Bur. et K. Schum. in Mart. Fl. Bras. viii. pars 2, 318 (1896).

BRITISH GUIANA. On the banks of the Essequibo River, fl. Jan., Feb., *Rich. Schomburgk* 334 (typus in Herb. Berol.).

A remarkable and rather isolated species, though the characters by which it was distinguished from its congeners by K. Schumann are not so striking when seen as they appear from description. The flowers seem to be solitary on the ends of the branchlets on the only

specimen extant, but only a single flower, from which the corolla has fallen, is still in situ. Schumann dissected a second flower, the parts of which we have seen in a capsule affixed to the sheet. The disk is patelliform and peltately attached, being strongly constricted in its basal third ; it is about 0·8 mm. long altogether, the constricted base being 0·3 mm. long. It seems to us somewhat misleading to describe the disk as " stipitate," without mentioning the length of the " stipes." Judging from a part of an ovary dissected by Schumann present in the capsule, the ovary (which appears to have been oblong-ovoid, not pyriform) cannot have been more than 1·5 mm. long, excluding the glabrous quadrangular basal portion of the style, which is present at its apex. It is densely ferrugineous-lepidote, and had 6–8 vertical rows of ovules in each loculus. The trifoliolate leaves and subulate calyx-lobes (3–3·5 mm. long) form the best distinguishing marks of the species.

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## III.—PRELIMINARY LIST OF FUNGI OR DISEASES OF ECONOMIC PLANTS IN TANGANYIKA TERRITORY.

G. B. Wallace.

The present list does not include records made prior to 1927. It is hoped that a complete list will be published later including these records, those made by German investigators before the British administration of the country, and further details concerning the distribution and economic importance of the organisms and diseases enumerated.

Unless otherwise stated the identification of the organism or disease has been made by the staff of the Imperial Mycological Institute, Kew. Where no number is given the material has been collected and identified by the officer whose initials appear after the record.

Each record shows the name of the host plant, the part affected, the organism or disease and, where known, the author and reference to the original description, the locality and date of collection. The initials of the collector are followed by a number indicating the exact identity of the specimen.

When material has been sent to the Imperial Mycological Institute a corresponding specimen has been retained in the Mycological Laboratory, Morogoro.

The following abbreviations are used : *G.B.W.*=G. B. Wallace, Mycologist, Department of Agriculture, Morogoro ; *H.H.S.*=H. H. Storey, Plant Pathologist, East African Agricultural Research Station, Amani.

**Agave sisalana** *Perrine ex Engelm.*

On leaves :

*Botryodiplodia Theobromae* Pat., Bull. Soc. Myc. Fr. viii, p. 136, 1892.

Near Moshi, 30.6.27. & 1.7.27., *G.B.W.* 947 & 1209.

*Colletotrichum Agaves* Cav., Hedwigia xxxi, p. 315, 1892. Mamba, 11.5.27, *G.B.W.* 937.

*Cucurbitaria Agaves* Syd. & Butl., Annal. Mycol. ix, 4, p. 406, 1911.
Kilosa, Jan. 1929, *G.B.W.* 1329.

*Microdiplodia Agaves* (Niessl.) Tassi, Bull. Lab. Orto, Bot. Sienna, p. 29, 1902.
Karanga, near Moshi, 2.3.28, *G.B.W.* 1095.

Physiological leaf diseases :
" Banding disease " at bases of leaves ; probably a deficiency disease. *G.B.W.*
" Sun scorch," most common at the end of the rains. *G.B.W.*
Rotting after cutting. *G.B.W.*

**Aloe** sp.
On leaves :
*Uromyces Aloës* (Cooke) P. Magn., Ber. Deutsch. Bot. Gesellsch, x, p. 48, 1892.
Marangu, 19.5.27, *G.B.W.* 1046.

**Ananas sativus** *Schult. f.*
In stem :
*Ceratostomella paradoxa* Dade, Trans. Brit. Myc. Soc. xiii, p. 191, 1928. (*Thielaviopsis paradoxa* (de Seynes) von Höhn.).
Kasanga, 9.8.28, *G.B.W.* 1276.

**Apium graveolens** *L.*
On leaves :
*Cercospora Apii* Fresen., Beitr. z. Mycol., Heft. iii, p. 97, 1863.
Nduruma, 23.6.27, *G.B.W.* 1164.

**Arachis hypogaea** *L.*
Rosette disease (virus). Muhesa, 1930, *H.H.S.*
On leaves :
*Cercospora personata* (B. & C.) Ellis, Journ. Mycol. i, p. 63, 1885.
Near Arusha, 18.6.27, *G.B.W.* 1161.

**Bougainvillaea spectabilis** *Willd.*
On twigs :
*Phomopsis* sp.
Morogoro, 30.6.30, *G.B.W.* 1398.

**Brassica oleracea** *L.*
On leaves :
*Alternaria circinans* (B. & C.) Bolle, Meded. Phytopath. Lab. Willie Commelin Sch. vii, p. 26, 1924.
Marangu, 13.5.27, *G.B.W.* 224 ; Kirua Rombo, 26.5.27, *G.B.W.* 957.

**Cajanus Cajan** *Millsp.* (*C. indicus* Spreng.).
On leaves :
*Cercospora Cajani* P. Henn., Hedwigia xii, p. 309, 1902.
Kasanga, 9.8.28, *G.B.W.* 1275.
*Oidiopsis taurica* (Lév.) Salm., Ann. Bot. xx, p. 187, 1906.
Kasanga, 9.8.28, *G.B.W.* 1274.
Stems :
*Lisea* sp.
Mountains above Ruvu, 14.6.30, *G.B.W.* 1388.
Roots :
*Rhizoctonia* sp. (?).
Mountains above Ruvu, 14.6.30, *G.B.W.* 1389 & 1390.

**Capsicum annuum** *L.*
On fruit :
*Alternaria tenuis* Nees, Syst. d. Pilze und Schwämme, p. 72, 1817.
Mwika, 16.5.27, *G.B.W.* 1096.
*Gloeosporium piperatum* Ell. & Ev., in Halstead, Rept. Botan. Dept. New Jersey Exper. Stat. xi, p. 358, 1890.
Kirua Rombo, 27.5.27, *G.B.W.* 1041.
*Vermicularia Capsici* Syd., Annal. Mycol. xi, p. 329, 1913.
Kirua Rombo, 27.5.27, *G.B.W.* 1041.

**Carica Papaya** *L.*
On leaves :
*Ovulariopsis Papayae* van der Bijl, Trans. Roy. Soc. S. Africa ix pt. 2, p. 189, 1921.
Moshi, 9.5.27, *G.B.W.* 863.
On fruit :
*Colletotrichum gloeosporioides* (Penz.) Sacc., Syll. iii, p. 735, 1884.
Morogoro, 12.11.28, *G.B.W.* 1309.

**Cinchona** sp.
On twigs :
*Phomopsis* sp.
Near Moshi, 10.5.27, *G.B.W.* 1050.

**Citrus Aurantium** *Auct.*
On leaves :
*Alternaria tenuis* Nees, loc. cit.
Marangu, 13.5.27, *G.B.W.* 941.
*Colletotrichum gloeosporioides* (Penz.) Sacc., loc. cit.
Mishati, 22.5.27, *G.B.W.* 1044.
At collar :
*Cytospora* sp.
Moshi, Feb. 1930, *G.B.W.* 1369.

In fruits :

*Nematospora Coryli* Pegl., Rendic. della R. Accad. dei Lincei, Seduta del 7 Nov. 1897.

Moshi, 27.1.30, *G.B.W.* 1371.

**C. limonia** *Osbeck.*

On twigs and branches :

*Haplosporella* (*Sphaeropsis*) sp. The spores are intermediate in size between *Sp. malorum* and *H. hesperidica* Speg. : average of 20 is 18·3 x 10·6, range 16–21 x 9–12 microns.

Morogoro, 13.11.29, *G.B.W.* 1353.

On bark over form of canker :

*Physalospora fusca* N. E. Stevens, Mycologia xviii, p. 210, 1926.

Morogoro, 16.11.29, *G.B.W.* 1354. Confirmed by N. E. Stevens.

**Cocos nucifera** *L.*

On leaves :

*Pestalozzia palmarum* Cooke, Grevillea iv, p. 115, 1876.

Bagamoyo, 31.8.27, *G.B.W.* 1169.

On leaf sheaths :

*Diplodia epicocos* Cooke, Grevillea v, p. 102, 1877.

Bagamoyo, 31.8.27, *G.B.W.* 1172.

Physiological disease on nuts :

" Gummosis," as described by Welsford, Rept. of Mycologist, Dept. Agric., Zanzibar, 1926. *G.B.W.*

**Coffea arabica** *L.*

On leaves :

*Cercospora coffeicola* B. & C., Grevillea ix, p. 99, 1881.

Uluguru Mountains, 21.8.28, *G.B.W.* 1284.

*Colletotrichum coffeanum* Noack, Zeitschr. f. Pflanzenkr. xi, p. 202, 1901.

Near Moshi, 10.5.27, *G.B.W.* 865.

*Hemileia vastatrix* B. & Br., Gard. Chron., p. 1157, 1869.

Uluguru Mountains, 21.8.28, *G.B.W.* 1283.

*Leptosphaeria coffeicola* Maubl. in Delacroix & Maublanc " Maladies des Plantes Cultivées dans les Pays Chauds " p. 329, 1911.

Uluguru Mountains, 21.8.28, *G.B.W.* 1295.

On twigs :

*Colletotrichum coffeanum* Noack., loc. cit., associated with die-back in **C. arabica,** and, together with a twig-boring beetle, with die-back in **C. robusta.**

Marangu, 13.5.27, *G.B.W.* 1119.

*Leptosphaeria* sp.

Tukuyu, 16.11.28, *G.B.W.* 1315 : Moshi, Nov. 1928, *G.B.W.* 1316-1318.

" Witches' Broom " (physiological ?).

Moshi, 1927, *G.B.W.*

On stems :

*Phomopsis* sp.

Singida, 9.8.28, *G.B.W.* 1278 & 1279.

Cherries :

" Cherry-fall " (physiological ?) descr. in Tanganyika Territory Dept. Agric. Annual Report 1929/30, pt. 2, pp. 46-47, and Mycol. Leaflet No. 7, 1930.

Near Moshi, 8.2.30, *G.B.W.* 1374.

In beans :

*Nematospora Coryli* Pegl., loc. cit., disease described in Tang Terr. Dept. Agric. Ann. Rpt. 1929/30, pt. 2, pp. 45-46, and Mycol. Leaflet No. 9, 1930 ; full account in " Tropical Agriculture," Vol. VIII, pp. 14-17, 1931.

Near Moshi, 1.1.30, *G.B.W.* 1383.

In roots :

" *Armillaria mellea* disease."

Arusha, 26.6.27, *G.B.W.* 1110.

*Rhizoctonia bataticola* (Taub.) Butl. (*Macrophomina Phaseoli* (Maubl.) Ashby, Trans. Brit. Myc. Soc. xii, p. 141, 1927.).

Singida, 9.8.28, *G.B.W.* 1280.

**Cucurbita Pepo** *L.*

On leaves :

*Cercospora Cucurbitae* Ell. & Ev., Journ. of Mycol. iv, p. 3. 1888.

Kilosa, 17.9.27, *G.B.W.* 1187.

**Dianthus Caryophyllus** *L.*

On leaves :

*Uromyces caryophyllinus* (Schrank) Wint.

Mountains above Morogoro, 19.6.30, *G.B.W.* 1395.

*Septoria Dianthi* Desm., Ann. Sci. Nat., 3 sér., xi, p. 346, 1884.

Near Arusha, 2.5.27, *G.B.W.* 836.

**Dolichos Lablab** *L.*

In seeds :

*Nematospora Coryli* Pegl., loc. cit.

Morogoro, Oct. 1929, *G.B.W.* 1356.

**Dracaena** sp.

On leaves :

*Dothiorella* sp.

Near Moshi, 18.6.27, *G.B.W.* 1113.

**Eriodendron** *sp.*

On leaves :

*Ramularia Eriodendri* Racib.

Morogoro, 17.9.29, *G.B.W.* 1343.

**Eriobotrya japonica** *Lindl.*

On leaves :

*Ascochyta Eriobotryae* Vogl., Ann. R. Acc. Agric., Torino LI, p. 22 (Extr.), 1908.

Near Moshi, 18.6.27, *G.B.W.* 1162.

**Ficus Carica** *L.*

On leaves :

*Kuehneola Fici* Butl., Annal. Mycol., xii, p. 76, 1906.

Near Arusha, 2.5.27, *G.B.W.* 838.

**Fragaria vesca** *L.*

On leaves :

*Mycosphaerella Fragariae* (Tul.) Oudem., Révis. Champig. ii, p. 216, 1897.

Near Moshi, 25.6.27, *G.B.W.* 958.

**Gossypium hirsutum** *L.*

On leaves :

*Alternaria tenuis* Nees, loc cit.

Morogoro, 31.10.27, *G.B.W.* 1219 ; Kilosa, 15.9.27.

*Bacterium malvacearum* E.F.S. " Bacteria in relation to plant diseases," i, p. 171, 1905.

Morogoro, 19.6.28, *G.B.W.* 1247.

*Kuehneola Gossypii* Arthur, North American Flora, vii, p. 187, 1912.

Near Morogoro, 23.9.27, *G.B.W.* 1195.

*Mycosphaerella gossypina* (Atk.) Earle, Bull. Torrey Bot. Club, xviii, p. 307, 1891.

Kilosa, 15.9.27, *G.B.W.* 1194 ; near Morogoro, 13.9.27, *G.B.W.* 1179.

*Phyllostica Malkoffii* Bubak, Annal. Mycol. vi, p. 24, 1908.

Morogoro, 9.6.28, *G.B.W.* 1243.

*Ramularia areola* Atk., Bot. Gaz. xv, p. 166, 1890.

Kilosa, 2.3.28, *G.B.W.* 1176.

On stems :

*Bacterium malvacearum* E.F.S., loc. cit.

Near Morogoro, 24.6.28, *G.B.W.* 1248.

*Diplodina* sp.

Ufipa, July 1928, *G.B.W.* 1262.

In bolls :

*Aspergillus niger* van Tiegh, Ann. Sci. Nat. Bot., ser. V, viii. p. 240, 1867.

Kilosa, 17.9.27, *G.B.W.* 1203.

*Bacterium malvacearum* E.F.S. loc. cit.

*G.B.W.*

*Diplodia gossypina* Cooke, Grevillea vii, p. 95, 1879.

Morogoro, 3.9.27, *G.B.W.* 1215.

*Gibberella moniliformis* Winel., Jour. Agr. Res. xxviii, p. 920, 1924.

Near Morogoro, 13.7.28, *G.B.W.* 1257.
*Monilia sitophila* group.
Near Kilosa, 22.9.27, *G.B.W.* 1196.
*Nematospora Gossypii* A. & N., Ann. of Bot. XL, clvii, p. 76, 1926.
Morogoro, 9.12.28, *G.B.W.* 1319.
On roots :
*Rhizoctonia Crocorum* (Pers.) D.C., Fl. Franç., vi, p. 110, 1815.
Morogoro, 11.7.28, *G.B.W.* 1256.

**Hemerocallis aurantiaca** *Baker*
On leaves :
*Vermicularia liliacearum* Westend., Prodrom. Florae Batavae, II, pt. iv, p. 113, 1866.
Near Arusha, 2.5.27, *G.B.W.* 828.

**Hibiscus esculentus** *L.*
On leaves :
? *Colletotrichum Hibisci* Pollacci, Atti Ist. Bot. Pavia, II, ser. v, p. 16, 1896.
Morogoro, 28.8.28, *G.B.W.* 1289.
*Libertella affinis* D. Sacc., Atti Soc. Ven. Trent di Sc. Nat. II, ser. ii, p. 477, 1896.
Morogoro, 28.8.28, *G.B.W.* 1292.

**Manihot Glaziovii** *Müll.—Arg.*
On leaves :
Mosaic or Leaf-curl (virus).
1930, *H.H.S.*

**M. utilissima** *Pohl*
On leaves :
*Cercospora Henningsii* Allesch., in P. Henn. Die Pflanzenwelt Ostafrikas, teil C, p. 35, 1895.
Marangu, 13.5.27, *G.B.W.* 943.
Mosaic or Leaf-curl (virus).
1930, *H.H.S.*

**Morus alba** *L.*
On stem :
*Sphaeropsis Mori* Berl.
Morogoro, 18.10.29, *G.B.W.* 1350.
On leaves :
*Kuehneola Fici* Butl., loc. cit.
Morogoro, 28.7.29, *G.B.W.* 1336.

**M. indica** *L.*
On leaves :
*Ovulariopsis moricola* Del., Bull. Soc. Myc. France xix, p. 347, 1903.
Morogoro, 31.7.28, *G.B.W.* 1265.

*Septogloeum Mori* (Lev.) Br. & Cav., I Funghi Parass. No. 21, 1892. (Exsicc. with descr.).
Mishati, 22.5.27, *G.B.W.* 934.
and stems :
*Bacterium Mori* B. & M., emend. E.F.S.
Ident. *E. M. Doidge.*
On stems :
*Eutypa ludibunda* Sacc. Syll. I, p. 167, 1882.
Morogoro, 21.10.29, *G.B.W.* 1351.
*Sphaeropsis heterospora* Passer., Mem. R. Accad. Lincei, Roma, 4 ser. VI, p. 100, 1890.
Morogoro, 20.11.28, *G.B.W.* 1310.

**Musa sapientum** *L.*
On fruit :
*Gloeosporium Musarum* Cooke & Mass., Grevillea xvi, p. 3, 1887.
Kirua Rombo, 27.5.27, *G.B.W.* 788.

**Nerium Oleander** *L.*
On leaves :
*Cercospora neriella* Sacc., Mich. ii, p. 294, 1881.
Near Moshi, 18.6.27, *G.B.W.* 1118.
Leaves and stems :
*Pseudomonas Savastanoi* E.F.S., var. *Nerii* C. O. Smith, Phytop. xviii, 6, 1928.
Morogoro, 19.8.29, *G.B.W.* 1340, det. *G.B.W.*

**Nicotiana Tabacum** *L.*
On leaves :
*Erisiphe cichoracearum* DC., Fl. Franç. ii, p. 274.
Moshi, 26.4.27, *G.B.W.* 874 ; 12.5.27, *G.B.W.* 939.
Leaf-curl (prob. physiological).
1930, *H.H.S.*

**Oryza sativa** *L.*
On heads :
*Phyllosticta glumarum* Sacc., in Nuovo Giorn. Bot. Ital., N.S. xxiii, 2, p. 207, 1916.
Kasanga, Uluguru Mountains, 8.8.28, *G.B.W.* 1271b.

**Oxalis sp.** (wild).
On leaves :
*Aecidium* sp., appar. not of *P. Maydis* Béreng.
Marangu, 13.5.27, *G.B.W.* 944.

**Panicum maximum** *Jacq.*
On leaves :
*Coniosporium inquinans* Dur. & Mont., Flore Alger. Cryptog. i, p. 327, 1849.
Near Morogoro, 13.5.28, *G.B.W.* 1258.

**Pennisetum ciliare** (*L.*) *Link.*
In heads :
*Sphacelia* sp.
Coll. A. H. Ritchie.
*Cerebella* sp. on the *Sphacelia* sp.
Coll. A. H. Ritchie.

**Pennisetum spicatum** *Schult.* (*P. typhoideum* Stokes).
On leaves :
*Phyllachora Penniseti* (?) Sydow, in Annal. Mycol. xiii, p. 39, 1915.
Morogoro, 5.7.28, *G.B.W.* 1253.
*Puccinia Penniseti* Zimmerm., Bericht. Deutsche Ostafrika ii, p. 16, 1904.
Kimamba, 22.9.27, *G.B.W.* 1204.
In heads :
*Sphacelia* sp.
Kimamba, 22.9.27, *G.B.W.* 1183.
*Cerebella Sorghi-vulgaris* Subram., Journ. Asiatic Soc., Bengal, N.S. xvii, p. 206, 1921.
*G.B.W.* 1183.

**Phaseolus acutifolius** *A. Gray.*
In seeds :
*Nematospora Coryli* Pegl., loc. cit.
Morogoro, 8.8.30, *G.B.W.* 1399.

**P. lunatus** *L.*
In seeds :
*Nematospora Coryli* Pegl., loc. cit.
Morogoro, 15.10.29, *G.B.W.* 1348.

**P. radiatus** *L.*
On leaves :
*Erysiphe Polygoni* DC., Fl. Franç. ii, p. 273, 1805.
Morogoro, 15.8.28, *G.B.W.* 1282.
In seeds :
*Nematospora Coryli* Pegl., loc. cit.
Morogoro, 8.8.30, *G.B.W.* 1404, det. *G.B.W.*

**P. vulgaris** *L.*
On leaves :
*Uromyces appendiculatus* (Pers.) Link, in Observ. ii, p. 28, 1816.
Mamba, near Moshi, 12.5.27, *G.B.W.* 940 : Kirua Rombo, near Moshi, 26.5.27, *G.B.W.* 956.
*Isariopsis griseola* Sacc., Michelia i, p. 273, 1878.
*G.B.W.* 956 (see above).
On pods :
*Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. & Cav., Funghi Parass., no. 50, 1892.
Mkuu, near Moshi, 28.5.27, *G.B.W.* 1042.

On roots :

*Rhizoctonia bataticola* (Taub.) Butl. (C strain) (*Macrophomina Phaseoli* Ashby), loc. cit., probably.

Lushoto, May 1930, *G.B.W.* 1380.

**Prunus Persica** *Stokes.*

On leaves :

*Puccinia Pruni-spinosa* DC., Synop. Method. Fung., p. 226, 1801.

Near Moshi, 10.5.27, *G.B.W.* 866.

**Ricinus communis** *L.*

On leaves :

*Cercosporina ricinella* (Sacc. & Berl.) Speg. Ann. Mus. Nac. Buenos Aires, xx, p. 429, 1910.

Mwika, 16.5.27, *G.B.W.* 952.

*Ovulariopsis* sp.

Kilosa, 18.9.27, *G.B.W.* 1190.

*Melampsorella Ricini* (Biv. Bern.) de Toni, in Saccardo, Syll. VII, p. 596, 1888.

Mgeta, Uluguru Mountains, 27.9.29, *G.B.W.* 1345.

**Rosa** sp.

On leaves :

*Sphaerotheca Humuli* (DC.) Burr., Bull. Illinois Stat. Laborat. of Nat. Hist.

Near Arusha, 22.6.27, *G.B.W.* 1124.

On twigs :

*Gloeosporium* sp.

Morogoro, 29.8.28, *G.B.W.* 1295.

*Pestalozzia versicolor* Speg., Michelia i, p. 479, 1879.

Morogoro, 29.8.28, *G.B.W.* 1293.

**Saccharum officinarum** *L.*

On leaves :

*Cercospora longipes* Butl., Mem. Dept. Agric. India, Bot. Ser. I, 3, p. 44, 1906.

Mkiuni, Uluguru Mountains, 21.8.28, *G.B.W.* 1287.

Mosaic. (East Afr. Agr. Res. Stat., Amani, 1st Ann. Rpt. 1928-29).

**Sansevieria** *sp.*

On leaves :

*Leptosphaeria* sp.

S. Pare Mountains, Dec. 1929, *G.B.W.* 1327.

**Solanum Melongena** *L.*

On leaves :

*Alternaria* sp. (not *A. Solani*).

Near Moshi, 21.4.27, *G.B.W.* 797.

**S. tuberosum** *L.*

On leaves :

*Alternaria Solani* (E. & M.) J. & G., Vermont Agr. Exp. Stat. Bull. 72, p. 25, 1899.

Mwika, 16.9.27, *G.B.W.* 953.

**Sorghum vulgare** *Pers.*

On leaves :

*Puccinia purpurea* Cooke, Grevillea, v, p. 15, 1876.

Near Arusha, 18.6.27, *G.B.W.* 1160.

*Darluca filum* (Biv.) Cast., Catal. Plantes Marseille, Suppl., p. 53, 1851. On *P. purpurea.*

*G.B.W.* 1160 (see above).

On heads :

*Acrothecium lunatum* Wakker, Ziekten van het Suikerriet, p. 196, 1898.

Morogoro, 7.6.28, *G.B.W.* 1231 (5).

*Alternaria tenuis* Nees (group), loc. cit.

Morogoro, 7.6.28, *G.B.W.* 1232.

*Choanephora Cucurbitarum* (Berk. & Rav.) Thaxter, in Rhodora v, p. 97, 1903.

Morogoro, 7.6.28, *G.B.W.* 1231 (4).

*Fusarium* sp.

Morogoro, 7.6.28, *G.B.W.* 1231 (a).

*Gibberella moniliformis* Wineland.

Morogoro, 7.6.28, *G.B.W.* 1231 (1).

*Phoma insidiosa* Tassi, Bull. Lab. Bot. R. Univ. Siena, i, p. 8, 1897.

Morogoro, 7.6.28, *G.B.W.* 1233.

*Rhinotrichum cucumerinum* Berk. & Curt., Grevillea, iii, p. 109, 1875.

Morogoro, 7.6.28, *G.B.W.* 1231 (b).

*Trichothecium roseum* (Pers.) Link, Observ. Mycol. i, p. 16, 1809.

Morogoro, 7.6.28, *G.B.W.* 1228.

In grains :

*Sorosporium Reilianum* (Kuehn) McAlp., Smuts of Australia, p. 181, 1910.

Moshi, 10.5.27, *G.B.W.* 864.

*Sphacelotheca cruenta* (Kuehn) Potter, Phytopathology, ii, p. 98, 1912.

Kilosa, 16.9.27, *G.B.W.* 1180 ; Kilosa, 17.9.27, *G.B.W.* 1205.

*S. Sorghi* (Link.) Clint., Journ. of Mycol. viii, p. 140, 1902

Kimamba, 23.9.27, *G.B.W.* 1191 ; Morogoro, 18.6.28, *G.B.W.* 1246.

**Thea sinensis** *L.*

On leaves :

*Colletotrichum Camelliae* Massee, Kew Bull. 1899, p. 91.

Amani, Oct. 1930, *H.H.S.*

Scabbed leaf (physiological, fide Petch) Amani, Oct. 1930, *H.H.S.*

Roots :

" *Armillaria mellea* disease."

Ambangulu, Jan. 1930, *H.H.S.*

**Triticum vulgare** *Vill.*

On leaves :

*Puccinia graminis* Pers., Disp. Meth., p. 29, 1797.

Singida, 9.8.28, *G.B.W.* 1281.

**Tropaeolum majus** *L.*

On leaves :

*Oidiopsis taurica* (Lév.) Salm., loc. cit.

Morogoro, 8.10.29. *G.B.W.* 1346.

**Vangueria acutiloba** *Robyns.*

On leaves :

*Hemileia Woodii* Kalchbr. & Cooke, affin., Grevillea ix, p. 22, 1880.

Marangu, 14.5.27, *G.B.W.* 930.

**Vigna unguiculata** *Walp.* (*V. Catjang* Walp. ; *V. sinensis* Endl.).

On leaves :

*Cercospora cruenta* Sacc., Michelia, ii, p. 144, 1880.

Kirua Rombo, near Moshi, 27.5.27, *G.B.W.* 1032.

In seeds :

*Nematospora Coryli* Pegl., loc. cit.

Morogoro, 29.7.30, *G.B.W.* 1402.

**Washingtonia filifera** *H. Wendl.*

On leaves :

*Diplodia epicocos* Cooke, loc. cit.

Morogoro, 28.8.28, *G.B.W.* 1288.

*Pestalozzia versicolor* Speg., loc. cit.

Morogoro, 28.8.28, *G.B.W.* 1294.

*Phoma palmicola* Winter, Grevillea xv, p. 92, 1887.

Morogoro, 28.8.28, *G.B.W.* 1290.

**Zea Mays** *L.*

On leaves :

*Puccinia Maydis* Béreng., Atti Riun. sc. Ital., Milano, vi, p. 475, 1844.

Near Moshi, 12.5.27, *G.B.W.* 938 ; near Moshi, 14.5.27, *G.B.W.* 946.

*Sclerospora* sp.

Near Muhesa, May-June 1928, *H.H.S.*

Streak (virus).

Prevalent near coast, also at Amani, Arusha, Makuyini, Pare Mountains, 1930, *H.H.S.*

**Zinnia** *sp.*
On branches :
*Oidium* sp.
Morogoro, 8.10.29, *G.B.W.* 1347.

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## IV.—ENTANDROPHRAGMA CYLINDRICUM.

A. C. Hoyle.

The tree producing " West African Cedar " or " Penkwa," now known as *Entandrophragma cylindricum* Sprague, was first described in 1908 as *Pseudocedrela cylindrica* Sprague (*Kew Bull.* 1908 : 257), and was transferred to the genus *Entandrophragma* in 1910 (Kew Bull. 1910 : 180).

The original type-specimens (Thompson No. 16 ex Gold Coast), have been examined and compared with the figure in Thompson's Report on Forests of the Gold Coast, Pl. 10 (Colonial Reports—Miscellaneous No. 66, 1910). The fruits in the original collection, bearing this number, included a mixture, comprising young fruits correctly associated with the leaves, together with the larger central columnar axes of two fruits which are those of another species, probably *E. macrophyllum* A. Chev. Possibly these axes were picked up under the same tree, and were assumed—in the absence of direct evidence—to represent the mature stage of the same species. This mixture of specimens, for which the collector was responsible, resulted in a confusion in the original description and figure of the fruit, both types being shown on the same plate, and the larger of them being described. The fruit figured on the left of the illustration cited is not that of *E. cylindricum*. For this reason, and as the original description did not include the flowers, which are now available in quantity, it seems desirable to redescribe the species. The material from which the new description is drawn includes young branchlets, young and old leaves, showing a wide variation in the shape and size of the leaflets, and inflorescences, as well as numerous fruits collected by Mr. J. D. Kennedy, of the Nigerian Forest Service, at Sapoba, Nigeria, and field notes kindly supplied by him. Another number of Mr. Thompson's (No. 34, in Herb. Kew) includes a pure collection of the young fruits.

**Entandrophragma cylindricum** *Sprague.* — *Pseudocedrela cylindrica* Sprague in Kew Bull. 1908 ; 257, partly ; *E. rufa* A. Chev. Veg. Ut. Afr. Trop. Franç. 5 : 201 (1909) (Meliaceae). Near *E. excelsum* Sprague, but differing in its usually much smaller leaflets, which are prominently reticulate above, and in its almost perfectly cylindrical fruit.

A large tree. *Branchlets* acutely angular or ribbed, at first greyish or brown-tomentellous, later puberulous, with ribs decurrent from the bases of the leaves ; terminal bud acuminate, densely brown-tomentellous. *Leaves* usually 6–9-jugate, 30–40 cm. long, but on certain branchlets (probably those producing young leaves

late in the season) the leaves may be only 3–5-jugate and 13–25 cm. long; rhachis ferruginous-tomentellous in the lower part, where it is flattened on the upper side and more or less winged, minutely puberulous in the upper part and terete; leaflets 1·5–3·5 cm. distant, with petiolules 1–3 mm. long, the lower leaflets ovate to ovate-oblong, the upper oblong to oblong-lanceolate, more or less unequal-sided, larger on the upper side, 4·5–14 cm. long, 2·5–4 cm. broad, base more or less inequilateral, cuneate to broadly rounded, apex shortly and obtusely, rarely acutely, acuminate, or occasionally obtusely apiculate, glabrous except for occasional tufts of hair in the axils of the nerves, more or less shining above and closely reticulate with prominent veinlets, the midrib and lateral nerves prominent below with veinlets less conspicuous than on the upper side; lateral nerves 7–11 on each side of the midrib, obliquely ascending, branching and arching at about 0·75–1 cm. from the margin. *Panicles* axillary, lax, up to about 30 cm. long and 12 cm. broad, slender for the genus, the rhachis slender and ribbed, more or less fulvous-puberulous, lateral branchlets few and slender, up to 10 cm. long, bearing numerous short 2–10-flowered cymes, lower part of rhachis and branchlets naked; bracts and bracteoles minute, caducous; flowers small for the genus, appearing star-like when open, globose in bud, up to 7 mm. across when fully expanded; pedicels slender, 1·5–2 mm. long, tomentellous, jointed about the middle or near the base; calyx cupular and open in bud, puberulous outside, less than 1 mm. long, with 5 minute teeth, later spreading and splitting irregularly into 3–5 lobes; petals imbricate, about 3 mm. long and 1·5 mm. broad, oblong-ovate from a broad sessile base, obtuse (often apparently acuminate owing to the revolute margins), tomentellous outside; staminal tube depressed globose, 1·25 mm. across, minutely adnate to the inconspicuous disc; anthers exserted well beyond the teeth of the tube, narrowly deltoid, apex truncate or emarginate, base sub-sagittate, basifixed on very short filaments which arise from the inner faces of the teeth of the tube; disc fused with the base of the ovary, pubescent; ovary ovoid, fleshy, 5-locular, stigma subsessile, ovoid-capitate, papillose, obscurely 4–5-costate, ovules 4–5 in each loculus, pendulous from the axis. Mature *capsule* pendulous, almost perfectly cylindrical, rounded at the base, obtuse or rounded at the apex, 12–14 cm. long, valves irregularly lenticellate outside, about 2·5 cm. broad about the middle, 2·5–3 mm. thick at the edges (with more or less of a ridge down the centre outside when young, which later becomes obscure or absent), shining light yellow, streaked and mottled with brown inside, distinctly showing the impressions of the seeds; central column yellow, broader towards the base where it is distinctly pentagonal, the septa becoming very prominent towards the apex, the axis between them strongly indented with the impressions of the seeds. *Seeds* 3–6 per loculus, attached distinctly to right and left of the centre of each face of the axis, rectangular, convex on the inner

face, concave on the outer, 1–1·5 cm. long, up to 1·6 cm. broad, with an oblong wing 6–9 cm. long and up to 2 cm. broad, both seed and wing coloured brown, the topmost seed usually only 7 mm. below the apex of the central column. Dehiscence is from the apex, the valves recurving from this end first, but later becoming free at the base also.

Tropical Africa: Gold Coast, near Mansu and Supom, *H. N. Thompson* 16, in part: type! *Thompson* 34. Ahiraso, *Chipp* 122, Popokyere, *Chipp* 200. S. Fomang Sec. Reserve, *C. Vigne* 1925. Ivory Coast: Agbo, *Chevalier* 16166, Guidéko, *Chevalier* 16390, between Guidéko and Soubré, *Chevalier* 19082. S. Nigera: Sapoba, *Kennedy* 315, 316, 317, 318, 1163, 1184, 1212, 1221.

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## V.—THE OCCURRENCE OF THE GENUS ACERATIUM (ELAEOCARPACEAE) IN AUSTRALIA. C. T. White.

The genus *Aceratium*, originally proposed by A. P. De Candolle (DC. Prodr. i. 519: 1824), was revived by Schlechter in Lauterbach's "Beiträge Zur Flora von Papuasien V." (Engl. Bot. Jahrb. liv. 100; 1916) who pointed out the very natural characters of the group, viz. opposite leaves, inflorescence shortened almost into an umbel, the pubescent or pilose edges of the petals and the fibrous mesocarp of the drupe. He listed twelve species, ten in New Guinea and one each in Amboina and the New Hebrides respectively. The occurrence of the genus in North-eastern Australia was therefore only to be expected.

**Aceratium concinnum** *C. T. White* comb. nov. *Elaeocarpus concinnus* S. Moore in Journ. Bot. lv. 303 (1917). *Aristotelia pubescens* C. T. White in Queensl. Dept. Agric. Bot. Bull. xx. 5 (1918).

North Queensland: Kuranda, *L. S. Gibbs*, 6332; Johnstone River, *H. G. Ladbrook*.

**Aceratium Doggrellii** *C. T. White* sp. nov.

*Arbor* circiter 25 m. alta, cortice griseo, ramulis pubescentibus. *Folia* opposita, petiolis 0·8–1 cm. longis pubescentibus; laminae 4·5–6·5 cm. longae, 1·5–2 cm. latae, elliptico-lanceolatae, basi cuneatae, apice acuminatae, margine minute denticulatae, supra glabrae, subtus pubescentes. *Racemi* axillares, breves, 0·5–1 cm. longi, rhachide et pedicellis dense ferrugineo-pubescentibus, pedicellis 0·8 cm. longis. *Sepala* late linearia, 1 cm. longa, utrinque dense pubescentia, intus prominenter 3-costata. *Petala* 1·5 cm. longa, apice obtuse 3-dentata, parte inferiore margine et intus in medio dense pilosa. *Filamenta* gracillima, circiter 6 mm. longa, apicem versus puberula, antheris puberulis 3 mm. longis apice breviter setiferis. *Ovarium* et styli pars inferior dense strigoso-pilosi.

North Queensland: State Forest Reserve 185, Danbulla (Atherton Tableland), flowering specimens, October 1929, *R. H. Doggrell*, A.22.

Tree about 80 ft. high (50 ft. bole) ; crown fairly dense, bark light grey ; flowers white.

Type in the Queensland Herbarium, Brisbane—syntype material deposited in the Kew Herbarium.

**Aceratium ferrugineum** *C. T. White* sp. nov.

*Arbor* 16 m. alta, ramulis dense ferrugineo-pubescentibus. *Folia* petiolata, petiolis 1·5 cm. longis dense et molliter pubescentibus ; laminae 7·5–13·5 cm. longae, 4·5–5 cm. latae, ellipticae vel obovatae, obtusae vel obtuse acuminatae, supra costa media excepta glabrae, subtus ferrugineo-pubescentes, margine denticulatae. *Racemi* breves, rhachide et pedicellis dense ferrugineo-pubescentibus, pedicellis 0·8–1 cm. longis. *Sepala* linearia, 1 cm. longa, utrinque dense pubescentia. *Petala* 1·5 cm. longa, apice 3-dentata, margine et in media parte inferiore dense pilosa. *Filamenta* gracillima, 5 mm. longa, antheris puberulis 4 mm. longis apice breviter setiferis. *Gynoecium* dense strigoso-hirsutum. *Drupa* ovoidea, circiter 3 cm. longa, tenuiter pilosa.

North Queensland : Mount Spurgeon, overhanging watercourses near the top of the mountain, old flowers and ripe fruits, February 1923, *A. L. Marrotsy* 33.

Tree about 50 ft. high, with long drooping limbs; fruit red and gold.

Type in the Queensland Herbarium, Brisbane—syntype material deposited in the Kew Herbarium.

Unfortunately the specimens are very fragmentary, having been collected and badly prepared during a very hot wet season ; all parts, however, are present and allow a fairly satisfactory description to be drawn up.

## VI.—MISCELLANEOUS NOTES.

Mr. G. E. Bodkin.—We learn that Mr. G. E. Bodkin, B.A., Dip. Agric. Camb., Entomologist, Palestine Department of Agriculture and Forests, has been appointed Director of Agriculture, Mauritius.

**Royal Horticultural Society Honours to Kewites.**—Mr. W. Dallimore, Keeper of the Museums, has been awarded the Victoria Medal of Honour. It will be remembered that Mr. C. H. Curtis, Editor of the Gardeners' Chronicle, received the V. M. H. last year.

Since the institution of the Associateship of Honour in 1930, the following Kewites, past and present, have been awarded this distinction :—

In 1930, among the first thirty Associates were Mr. G. H. Banks, Curator of the Glasgow Botanic Gardens ; Mr. E. W. Cooper, Foreman, Messrs. Sutton & Sons, St. Albans ; Mr. J. Coutts, Assistant Curator, Royal Gardens, Kew ; Mr. J. J. Gutteridge, Chief Superintendent and Curator of Parks and Gardens, Liverpool ; Mr. Walter Irving, late Assistant Curator, Royal Gardens, Kew ; and Mr. H. W. Page, gardener to Miss Moore, Bourton-on-the-Water.

In 1931, Mr. D. Bliss, Superintendent of Public Parks, Swansea ; Mr. T. W. Brown, Ministry of Agriculture, Egypt ; and Mr. C. Wakely, Horticultural Lecturer, Chelmsford.

In 1932, Mr. J. W. Besant, Keeper of Botanic Gardens, Glasnevin ; Mr. A. Hosking, late of the John Innes Horticultural Institution ; Mr. J. Jones, late of the Dominica Botanic Gardens ; Mr. G. T. Lane, late Curator of the Royal Botanic Gardens, Calcutta ; Mr. E. P. Long, Superintendent of the Viceregal Gardens, New Delhi ; Mr. T. D. Maitland, Superintendent of the Botanic Gardens, Victoria, British Cameroons ; Mr. J. W. Matthews, Curator of the Botanic Gardens, Kirstenbosch, South Africa ; Mr. W. Taylor, Curator of the Royal Gardens, Kew ; and Mr. R. O. Williams, Assistant Botanist, Trinidad.

Dr. O. Stapf has been awarded a Veitch Memorial Medal on the completion of the " Index Londinensis " up to the year 1920.

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**Curtis's Botanical Magazine Dedications, 1827-1927.***— Mr. Cuthbertson is much to be congratulated on having conceived and carried out the idea of producing a volume of portraits and biographical notices of the botanists, horticulturists and plant-collectors to whom volumes of the Botanical Magazine have been dedicated during the hundred years 1827 to 1927. The compilation is due mainly to Mr. E. Nelmes, Assistant Botanist at Kew, and will form a valuable work of reference for every botanical institution and, indeed, for the libraries of all who are interested in Horticulture.

This volume is particularly fitting in carrying the history of Horticulture to the year 1927, since all subsequent volumes of the Botanical Magazine will contain portraits of those to whom they are dedicated and there will thus be a complete record of portraits and biographical notices from the year 1827, which will be of the greatest value. The portraits have been gathered from many sources, often with considerable difficulty, and fortunately the Royal Horticultural Society has had the advantage of being able to make use of nearly sixty portraits preserved in the Kew collection of Portraits of Botanists. Though the Kew collection is always available for inspection, it is of very great value to have this fuller series of portraits reproduced in this volume, so that they can be more generally consulted. The volume appropriately commences with a portrait of William Curtis, the founder of the Botanical Magazine (1746-1799), together with a good account of his life and activities. The biographical notices are very well written and embody the principal points of interest in connection with the horticultural and botanical interests of the subjects of the various portraits.

In looking through the pages one comes across the faces of many familiar and well-known botanical friends, and also of many others,

*Portraits and biographical notices compiled by Ernest Nelmes and William Cuthbertson, V.M.H. Published for the Royal Horticultural Society, London, by Bernard Quaritch, Ltd. Price 30*s*.

who might easily have been forgotten had not this timely and welcome volume been produced to remind us of the great services they rendered in their time to the gardening fraternity.

Our best thanks are due to Mr. Cuthbertson for having undertaken the responsibility for the preparatory work and for all the labour that it has involved. The Botanical Magazine has been much enhanced by this interesting record of its past history and we hope it will also be very materially assisted by Mr. Cuthbertson's generosity in having arranged to place to the credit of the Botanical Magazine Account of the Royal Horticultural Society the sum which accrues from the sale of this interesting achievement.

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**Handbook of Coniferae.***—It is gratifying to see that the work of Messrs. Dallimore and Jackson on the Coniferae has been appreciated so much as already to have reached a second edition. For everyday use it is certainly the best book on that family that has ever been published in the English language. Gordon's " Pinetum," first issued in 1858, was a creditable work; it held the field for a good many years and ran to three editions, the last dated 1880. It was followed in 1881 by Veitch's " Manual of Coniferae," which had not much botanical value but was highly appreciated by people interested more especially in the history, cultivation and uses of Conifers. M. T. Masters did a good deal of work on the family, which was published at intervals, mostly in " The Gardeners' Chronicle," but he did not live to produce a comprehensive and detailed study of the whole family. The first man to tackle thoroughly the problems of the identification of conifers was the late Augustine Henry, and the result of his labours, as given to the world in " The Trees of Great Britain and Ireland," has very much simplified the task of those who are following him.

The great value of the present work is that it is practically an encyclopedia of the Yew and Conifer families. There is, we suppose, no species of Taxad or Conifer, tropical or temperate, which does not receive some notice, however brief it may be. The more important species receive very full treatment; *Pinus Laricio,* for instance, has five-and-a-half pages devoted to it; the Sitka Spruce and Douglas Fir nearly as much. A Key is provided for the identification of the larger and more important genera; this is followed by a detailed description of the species in alphabetical order accompanied by a full account of their history, their qualities as garden or park trees, their economic value in forestry and the characteristics and uses of their timber.

The chief new feature in this second edition is an appendix giving a descriptive list of species, varieties and hybrids published since the date of the first, and of others found to have been omitted. A welcome emendation is that of putting the name of the genus at the

*By W. Dallimore and A. B. Jackson. Second Edition. Edwin Arnold & Co., London, 1931, pp. xiv+582+8, Plates xxxi, Figs. 119. Price Two Guineas.

top of the right-hand page. Although the arrangement is alphabetical this greatly facilitates reference to a particular species.

As a book, the first edition had one serious defect. It was so loosely and weakly bound that a volume in constant use soon began to show signs of disintegration. That, however, was the fault of the publishers or the binders, not of the authors. It is to be hoped that this new edition will prove to have been produced in a fashion worthy of its admirable qualities.

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**The origin of Spartina Townsendii.**—The interest of botanists in the so-called "rice grass" of the mud flats of the Sussex, Hampshire, and Dorset coasts has been periodically renewed by publications dealing with its rapid spread on our south coast and on the opposite coast of France or with its economic value as a mud-binder. The earliest known collection of *S. Townsendii* was at Hythe on the edge of Southampton Water in 1870, but the plant was not named as a distinct species till 1881. The origin of *S. Townsendii* has been a matter of some doubt. Foucard (1894) suggested it was of hybrid origin, the putative parents being *S. alterniflora* (♀) and *S. stricta* (♂). Stapf (1908), after extensive studies, considered this explanation the most plausible of those then suggested and after further investigations in 1926 (Bot. Mag. t. 9125, 1927) he was still fully convinced as to its hybrid origin.

While morphological, historical, and biological facts pointed strongly to a hybrid origin for *S. Townsendii*, there remained the objection that the plant is fertile and breeds (relatively) true to type. It is, therefore, a matter of considerable importance that Dr. C. L. Huskins (late of the John Innes Horticultural Institution, Merton, and now of the Department of Botany, McGill University, Montreal) has, by cytological examination of *S. Townsendii*, *S. alterniflora*, and *S. stricta*, been able to support the theory of hybrid origin of "rice-grass" in a most convincing manner and to explain satisfactorily its fertility and non-segregation.

Huskins has shown [Genetica xii. 531. 1930 (1931)], that the somatic chromosome number of *S. Townsendii* is 126, by far the highest number yet recorded in the *Gramineae*, that of *S. alterniflora* 70, and that of *S. stricta* 56. The cytology is thus in favour of *S. Townsendii* having arisen as a sequence of interspecific hybridization followed by chromosome doubling. In modern cytological terms it is "an allopolyploid derived from the doubling of the chromosome number in the original hybrid plant." The true-breeding of *S. Townsendii* is possible because at gamete formation the chromosome complex can form bivalents, which result in a normal reduction of chromosome number and the production of fertile gametes. The increased number of chromosomes and, probably of still greater importance, the maintenance of full hybrid vigour in successive generations, accounts for the ecological success of the species.

*S. Townsendii* answers to every known test for a species and must be considered as the most clear-cut example we have at present of the evolutionary significance of allopolyploidy following hybridization in plants. Huskins makes the useful suggestion that by crossing *Spartina Michauxiana* with other species it might be possible to obtain a freshwater equivalent of *S. Townsendii*. W. B. T.

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**Cheilanthes Belangeri C. Chr. (Pellaea cambodiensis Baker).**—This plant was described in Ann. Bot. v. 213 (1891), from very poor material collected by Godefroy-Lebeuf in Cambodia. In 1910 Col. R. H. Beddome published a note on this species in the Gardeners' Chronicle, xlvii. 34, having identified certain specimens collected by J. H. Lace in Upper Burma with the Cambodian plant. In this note attention was drawn to certain curious bulbils which were found on the under surface of the fronds of the Burmese specimens. No such structures can be seen on the type specimen in the Kew Herbarium.

Dr. Christensen, when identifying a Lushai specimen as *Pellaea cambodiensis* a year or two ago suggested that the plant was merely a form of *Cheilanthes Belangeri* (Bory) C. Chr. (*C. varians* Hk.), which it closely resembled. The plant certainly possesses the discontinuous type of sorus found in *Cheilanthes* and cannot therefore be retained under *Pellaea*. Following up Dr. Christensen's suggestion, a critical examination of the Kew material of *Cheilanthes Belangeri* was carried out and revealed the significant fact that out of 29 sheets in the herbarium, 21 possessed bulbils exactly similar to those found in the Lace specimens. Two of these specimens in fact, Lobb 391 from Moulmein and Cuming 408 from Luzon, were quoted by Hooker in Spec. Fil. ii. 89 (1858) below his description of *Cheilanthes varians* Hk.

The bulbils appear to have been noticed as far back as 1868 by C. B. Clarke, who collected a specimen of *Cheilanthes Belangeri* in Dhamroy Dacca (no. 7687) and noted on the label, " With the same monstrosity (?) which occurs in the Cachar specimens." Here he was probably referring to a sheet in Herb. Kew collected by R. L. Keenan in Cachar which also possesses bulbils.

Since the bulbils on many of the Kew specimens are very few in number and become very easily detached in the dried condition, it is possible that the specimens without these structures may have possessed them in the living state. The bulbils become, therefore, a useful specific character of *Cheilanthes Belangeri*. Dr. Christensen has recently presented to Kew a duplicate specimen of this species collected by Pételot in Cambodia (no. 219), the type locality of *Pellaea cambodiensis* Bak. The specimen sent possesses no bulbils, but the portion retained by Dr. Christensen is said to show a few small ones.

From an examination of all the Kew material it became clear that fronds possessing a comparatively large number of bulbils never

show an abundance of sporangia. Also, from the fact that very young fronds frequently showed a rich development of bulbils, whereas older fronds on the same plant were almost without them, it seemed possible that the bulbils were a juvenile phenomenon in the main and were developed before the sporangia.

In addition to a great number of bulbil-bearing specimens from various parts of India collected by C. B. Clarke, R. H. Beddome, R. L. Keenan, Hooker & Thomson, Parish, Simons, Craib and Gamble, there are also sheets of this plant from Siam collected by Fleet-Surgeon C. G. Matthews, Dr. Kerr and Dr. E. Smith.

Dr. Christensen's original suggestion was that *Pellaea cambodiensis* might be regarded as a bulbiferous condition of *Cheilanthes Belangeri*, but from the evidence obtained it seems quite certain that the condition is a normal one in *C. Belangeri*. *Pellaea cambodiensis* becomes therefore a synonym.

*Aspidium sparsiflorum* (Hk.) Diels is another plant which sometimes develops on the fronds bulbils of a type similar to those in *Cheilanthes Belangeri*. In this case they arise towards the base of the pinnules—the frond being a simply pinnate one. They are much larger, however, being up to almost a centimetre in length though otherwise identical in appearance. F. B.

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George Michael Ryan.—It is with great regret that we learn of the death of Mr. G. M. Ryan, I.F.S. Retd., F.L.S., in London on the 15th January.

Ryan was appointed to the Indian Forest Service in the Presidency of Bombay in 1882 and retired after a long period of distinguished service in 1914. A man of wide interests, he took up keenly the self-imposed task of bringing the then little-known minor products of the forests into commercial use and did much pioneer work to that end. He wrote, over a period of years, several papers on the subject of river-training, with particular reference to the Indus, a river he had considerable opportunity to observe when serving in Sind. He was elected a Fellow of the Linnean Society in 1902. After his retirement he was active in the furtherance of arboriculture and the protection of trees in England. In this connection he became associated with the National Trust and was instrumental in securing the preservation of several old trees with historical associations in various parts of the country. For a few years he was closely connected with Kew, as Temporary Technical Assistant in the Herbarium and as Official Guide in the Gardens. Of kindly disposition, he made many friends by whom his loss will be much regretted. C. E. C. F.

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